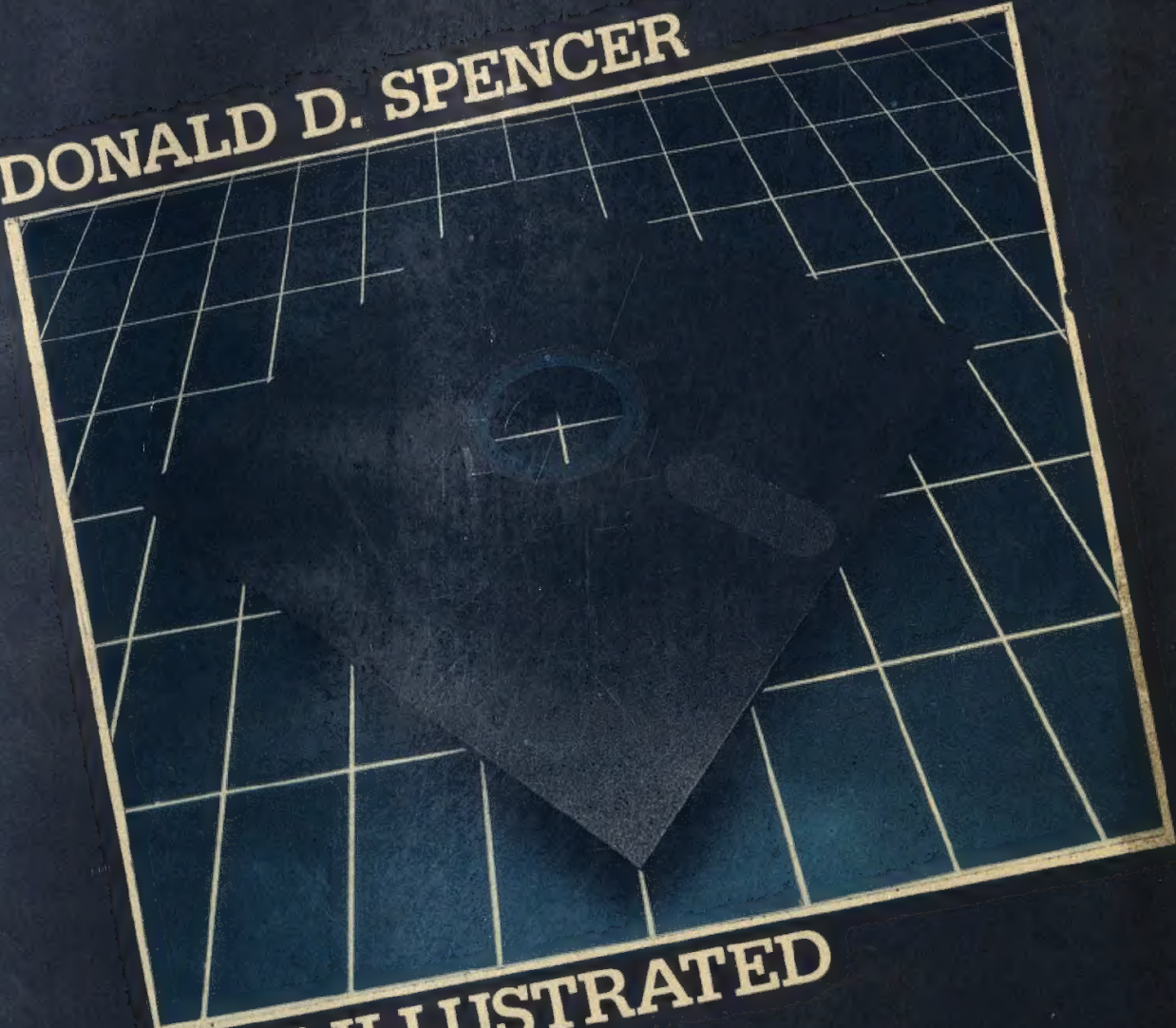
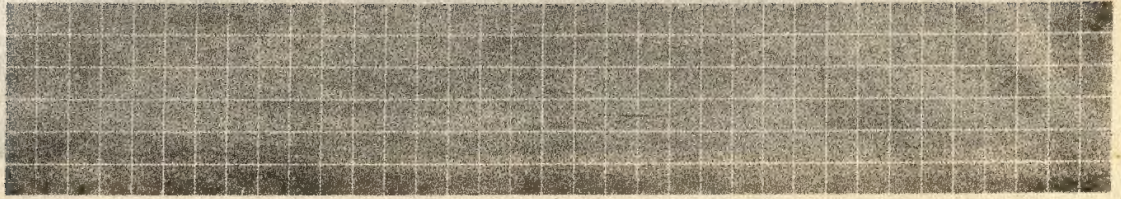


**DONALD D. SPENCER**



**THE ILLUSTRATED  
COMPUTER  
DICTIONARY**  
THIRD EDITION





# **The Illustrated Computer Dictionary**

**Third Edition**

Donald D. Spencer

NEW YORK



# The Illustrated Computer Dictionary

Third Edition

Donald D. Spencer



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## PREFACE

Computers are revolutionizing every aspect of our lives. The offices where we work, the stores in which we shop, the schools we attend, the banks that handle our money, even the devices we use in our homes are being radically altered by computers. Computer usage is growing by leaps and bounds in business, industry, government, colleges, schools, and utilities.

The primary objective of *The Illustrated Computer Dictionary* is to present concisely the most common terms currently used by computer scientists, information processing personnel, and other computer users. The book is for anyone who is using or who wants to learn more about computers. The third edition has been thoroughly updated and revised to reflect the dynamic changes and new developments in this rapidly growing field.

Familiarity with the vocabulary of any academic course, business, organization, or profession is absolutely essential to success. Lack of knowledge causes anger, failure, frustration, and loss of time and effort. This book will help students and other computer users overcome many of the problems associated with learning the terminology of an unfamiliar field. It may be used as a personal reference book or as a supplementary text. Managers, professionals, teachers, technical people, and others will find it a helpful resource.

The keynote of this book is clarity, with no sacrifice of authority or definitional precision. The definitions are simple and they stand as independent units of explanation. Most of the terms are explained in nontechnical language.

In those few cases that require special terminology, the expressions are carefully defined, and cross-references (in italics) indicate related terms or concepts. Illustrations help the reader understand many of the terms.

Special features of *The Illustrated Computer Dictionary* include:

**computer organizations** Short descriptions acquaint the reader with professional organizations such as ACM, ACPA, AEDS, AFIPS, ASM, AWC, DPMA, ICCE, IEEE-CS, and IFIPS.

**biographies** Notes on the lives of the most important people in computer science, with emphasis on their influence in the development of computer techniques and equipment; for example, Aiken, Atanasoff, Babbage, Boole, Eckert, Hollerith, Hoff, Jobs, Kilby, Noyce, Wozniak, Hopper, Liebniz, Mauchly, Napier, Pascal, Turing, von Neumann, Watson, Wiener, and Zuse.

**programming languages** Definitions of the important high-level languages: Ada, APL, BASIC, C, COBOL, COGO, FORTH, GPSS, LOGO, Pascal, PILOT, PL/C, PL/I, PROLOG, RPG, and SNOBOL—as well as many others.

**history** In addition to short sketches of famous people, there are also descriptions of many famous computers, such as the ABC, ASCC, COLOSSUS, EDSAC, EDVAC, ENIAC, IBM 650, STRETCH, System/360, and UNIVAC I.

**computers in society** Definitions of terms such as *cashless society*, *computer*



applications, computer literacy, microcomputers, privacy, and robots indicate the effects of computers on society

**applications software** Business people will find everyday terms such as *business graphics*, *word processing*, *electronic spreadsheets*, *computer security*, *database management*, *networks*, and *integrated software systems*.

**education** Computers are now used in all aspects of education, both administrative and instructional. Educators will find descriptions for many useful terms and acronyms, such as CAI, CMI, computer literacy, courseware, LOGO, and PILOT

**computer professionals** Programmers and analysts will find many useful terms, among them: *algorithm*, *artificial intelligence*, *computer graphics*, *fifth generation computers*, *robotics*, *expert system*, *heuristic*, *laser storage*, *multiprocessing*, *operating system*, *simulation* and *structured programming*.

At the end of the book you will find a section about "How To Buy a Personal Computer," excerpted from my Textbook, *Computers and Information Processing*.

I would like to thank the many educators, scientists, engineers, researchers, and authors who have identified new terms and written about new computer devices and techniques. Only through these people's works can I keep up-to-date with the ever-growing vocabulary of computer technology. I am particularly grateful to my wife, Rae, for typing the manuscript.

I hope this dictionary becomes a handy reference work and succeeds in helping readers learn about computers or solving their problems.

Donald D. Spencer  
Ormond Beach, Florida



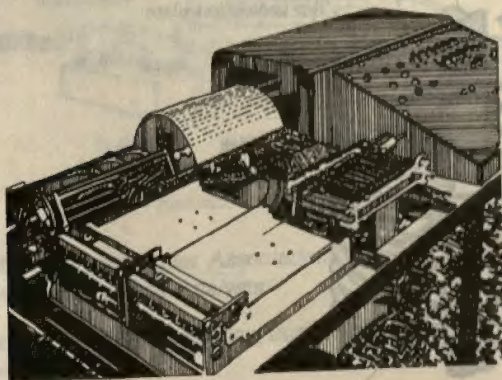
# A

**AAAI** Acronym for American Association for Artificial Intelligence, professional organization concerned with advancing artificial intelligence.

**abacus** Ancient device for doing simple calculations that uses movable beads threaded on a grid of wires. Still widely used in many oriental countries.

**abbreviated addressing** Modification of the direct address mode that uses only part of the full address and provides a faster means of processing data due to the shortened code.

**ABC** Acronym for Atanasoff-Berry Computer, the first electronic digital computer, built in 1939 by John Atanasoff and his assistant, Clifford Berry. See *Atanasoff, John V.* and *Berry, Clifford*.



ABC computer

**abend** Acronym for ABnormal ENDing. Early termination of a program due to an error condi-

tion, such as division by zero or trying to add a number and a letter.

**abort** Procedure for terminating a program when a mistake, malfunction, or error occurs.

**abscissa** X axis of a graph or chart. Contrast with *ordinate*.

**absolute address** Address that is permanently assigned by the machine designer to a particular storage location. Addresses 0000, 0001, 0002, and 0003 might be assigned to the first four locations in a computer's storage. Also called *machine address*.

**absolute coding** Coding that uses machine instructions and absolute addresses. Can be directly executed by a computer without prior translation to a different form. Contrast with *symbolic coding*.

**absolute movement** Movement of an object on the screen by providing the new location in terms of a specific X-Y coordinate pair. Contrast with *relative movement*.

**absolute value** Magnitude of a number without reference to positive or negative sign. Denoted in mathematical notation by enclosure in vertical bars:  $|+7| = |-7| = 7$

**AC** Acronym for Alternating Current, the type of electricity found in homes, schools, and businesses.

**acceptance test** Test used to demonstrate the capabilities and workability of a new computer system. Usually conducted by the manu-



## access

facturer to show the customer that the system is in working order.

**access** Generally, the obtaining of data. To locate desired data.

**access arm** Mechanical device in a disk file storage unit that positions reading and writing mechanisms.

**access code** Group of characters or numbers that identifies a user to the computer system.

**access mechanism** Mechanical device in the disk storage unit that positions the read/write heads on the proper tracks.

**access method** Any of the data management techniques available to users for transferring data between storage and an input/output device.

**access time** Time a computer takes to locate and transfer data to or from storage. Composed of *seek time* and *transfer rate*.

**accumulator** Register or storage location that temporarily holds the result of an arithmetic

or logic operation. Commonly used when a series of calculations are to be totaled.

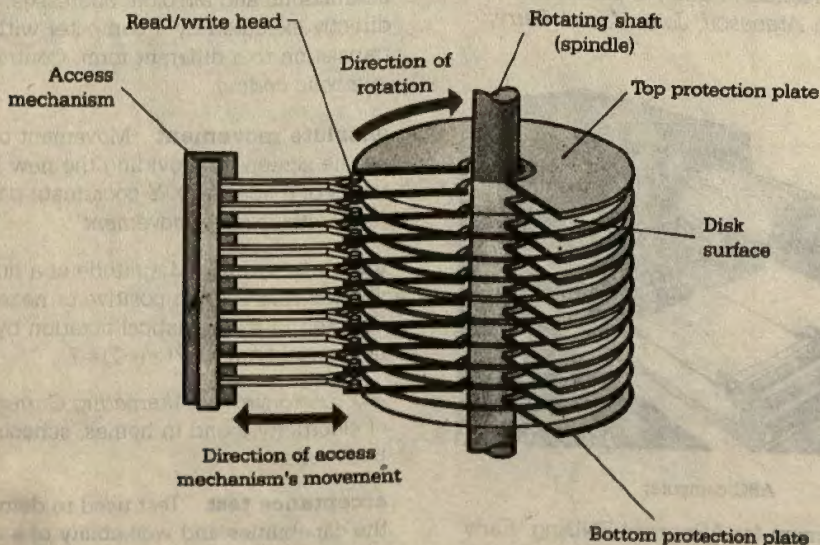
**accuracy** Degree of exactness of an *approximation* or measurement. *Accuracy* normally denotes absolute quality of computed results; *precision* usually refers to the amount of detail used in representing those results. Four-place results are less precise than six-place results; yet a four-place table could be more accurate than an erroneously computed six-place table.

**ACH** Acronym for *Association for Computers and the Humanities*.

**ACI** Acronym for Automatic Car Identification, a system used by railroad companies to identify railroad cars automatically.

**ACK** Acronym for ACKnowledge, an international transmission control code that is returned by a receiving terminal to a transmitting terminal to acknowledge that a frame of information has been correctly received. Contrast with NAK.

**ACM** Acronym for *Association for Computing Machinery*.



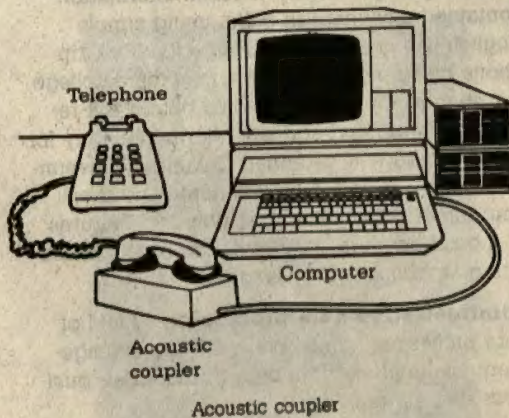
Access mechanism



**ACMST** Acronym for Association for Computers in Mathematics and Science Teaching, a professional organization directed toward college and secondary school mathematics and science teachers interested in educational uses of computers.

**acoustical sound enclosure** Device that fits over a printer or other machine to reduce noise. Most noticeable when absent. Also called *sound hood*.

**acoustic coupler** Modem that connects to a telephone handset with rubber cups. Converts signals from the computer into audible tones detected by the telephone mouthpiece, and converts telephone tones into electrical signals the computer can read. Also called acoustic modems, they are compatible with almost any telephone. In contrast, *direct-connect modems* require a modular telephone jack connected to the phone system. Speed is limited to about 1200 bits per second.



**ACPA** Acronym for Association of Computer Programmers and Analysts.

**action** Activity resulting from a given condition

**action entry** One of four sections of a decision table. Specifies what actions should be taken. See *action stub* and *condition entry*.

### action-oriented management report

Exception report used to alert management to abnormal situations that require special attention.

**action statement** Statement that tells the computer to perform some action.

**action stub** One of four sections of a decision table. Describes possible actions applicable to the problem to be solved. See *action entry* and *condition stub*.

**active cell** In an electronic spreadsheet, the cell on the matrix that is highlighted by the cursor. Information may be entered, altered, or deleted by the user when the cell is active.

**active file** File currently being used.

**activity** One of the subunits of work that comprise a task.

**activity ratio** When a file is processed, ratio of the number of records in the file that have activity to the total number of records in that file. Sometimes confused with *volatility*

**actuator** In a disk drive, mechanism that moves the read/write head to the desired position over the disk surface

**ACU** Acronym for Automatic Calling Unit, device that allows a business machine to make dial calls on a telephone network.

**Ada** High-level programming language developed by the Department of Defense for use in military systems. Named after Ada Augusta Lovelace, the first woman programmer. See *Lovelace, Ada Augusta*.

**ADAPSO** Acronym for Association of Data Processing Service Organizations.

**adapter** (1) Device that allows compatibility between different equipment. (2) Device that changes alternating current to direct current. Contrast with *inverting circuit*.

**adapter boards** Printed circuit boards that connect a system board to peripheral I/O de-



vices or add specialized functions to the system.

**adapter cards** Another name for *adapter boards*.

**adaptive systems** System displaying the ability to learn, change its state, or otherwise react to a stimulus. Any system capable of adapting itself to changes in its environment. Characterized by *heuristic learning*.

**A-D converter** See *analog-to-digital converter*.

**adder** Device capable of forming the sum of two or more quantities. See *parallel adder* and *serial adder*.

**add-in** Component that can be placed on a printed circuit board already installed in a computer, such as memory chips inserted in empty slots in a microcomputer.

**adding wheel** Toothed gear that allows the process of "carrying" to be accomplished mechanically. Used in *Pascal's calculator*.

**addition record** Record that results from the creation of a new record during the processing of a file

**add-on** Component or device added to a computer system to increase its storage capacity, to modify its architecture, or to upgrade its performance.

**address** Identification—such as a label, number, or name—that designates a particular location in storage or any other data destination or source.

**address bus** Bus that conveys address data from one system component to another.

**address decoder** Circuitry that enables data to be obtained from a particular location when its character code is provided.

**addressing** (1) Locating a required piece of data by specific techniques. (2) Data communications control method whereby the host com-

puter specifies the particular terminal for which it has data. Contrast with *polling*.

**address modification** Operation that causes an address to be altered in a prescribed way by a stored-program computer.

**address register** Register containing the address of the instruction currently being executed.

**address space** Complete range of addresses available to a computer user.

**address translation** Process of changing the address of an instruction or item of data to the address in internal memory at which it is to be loaded or relocated.

**add time** Time required for a computer to perform an addition, exclusive of the time required to obtain the quantities from storage and put the sum back into storage.

**ad hoc query** Ability to recall information contained anywhere in a file, using simple English-like commands. "Print city state zip phone by lastname by firstname where college is Columbia University" would obtain the requested name-and-address information only for those people who attended Columbia University, and would sort it by last name and then first name. One of the most powerful features of a good database program. See *data manipulating language*, *query language*.

**administrative data processing** Field of data processing concerned with the management or direction of an organization. See *business data processing*.

**ADP** Acronym for Automatic Data Processing. Data processing performed largely by automatic means.

**advanced BASIC** Advanced implementation of the BASIC programming language. Much more powerful than the original *BASIC*.

**AEDS** Acronym for *Association for Educational Data Systems*.



**AFCET** Acronym for *Association Francaise pour la Cybernetique Economique et Technique*, professional organization whose purpose is to bring together French scientists, computer users, computer manufacturers, and engineers interested in computer technology and applied mathematics.

**AFIPS** Acronym for *American Federation of Information Processing Societies*.

**AI** Acronym for *artificial intelligence*, the branch of computer science that works on getting computers to think like human beings. Much research into human intelligence is done for AI purposes.

**Aiken, Howard Hathaway** (1900–1973)  
Headed the team of people who designed and built the first electromechanical computer, the Automatic Sequence Controlled Calculator, at Harvard University, between 1937 and 1944. See *ASCC*.



Howard Hathaway Aiken

**airline reservation system** Online, direct access application in which a computing system is used to keep track of seat inventories,

flight schedules, and other information required to run an airline. Designed to maintain up-to-date data files and to respond, within seconds or less, to inquiries from ticket agents at locations remote from the main computer. (See page 6.)

**AISP** Acronym for *Association of Information Systems Professionals*.

**AL** Acronym for *Assembly Language*, programming language used at Stanford University for controlling robots. Not synonymous with *assembly language*. See *robot control languages*

**algebra** Form of mathematics in which letters representing numerical values can be operated upon according to basic rules of arithmetic.

**algebra of logic** System of logical relations expressed as algebraic formulas; first introduced by George Boole. See *Boolean algebra* and *Boole, George*

**ALGOL** Acronym for *ALGO*rithmic Language, an international high-level programming language used to code problem-solving algorithms.

**algorithm** Prescribed set of well-defined, unambiguous rules or processes for the solution of a problem in a finite number of steps. Commonly used as integral parts of computer programs. Thus the study of computers and the study of algorithms are closely related subjects. Contrast with *heuristic*

**algorithmic language** Language designed for expressing algorithms.

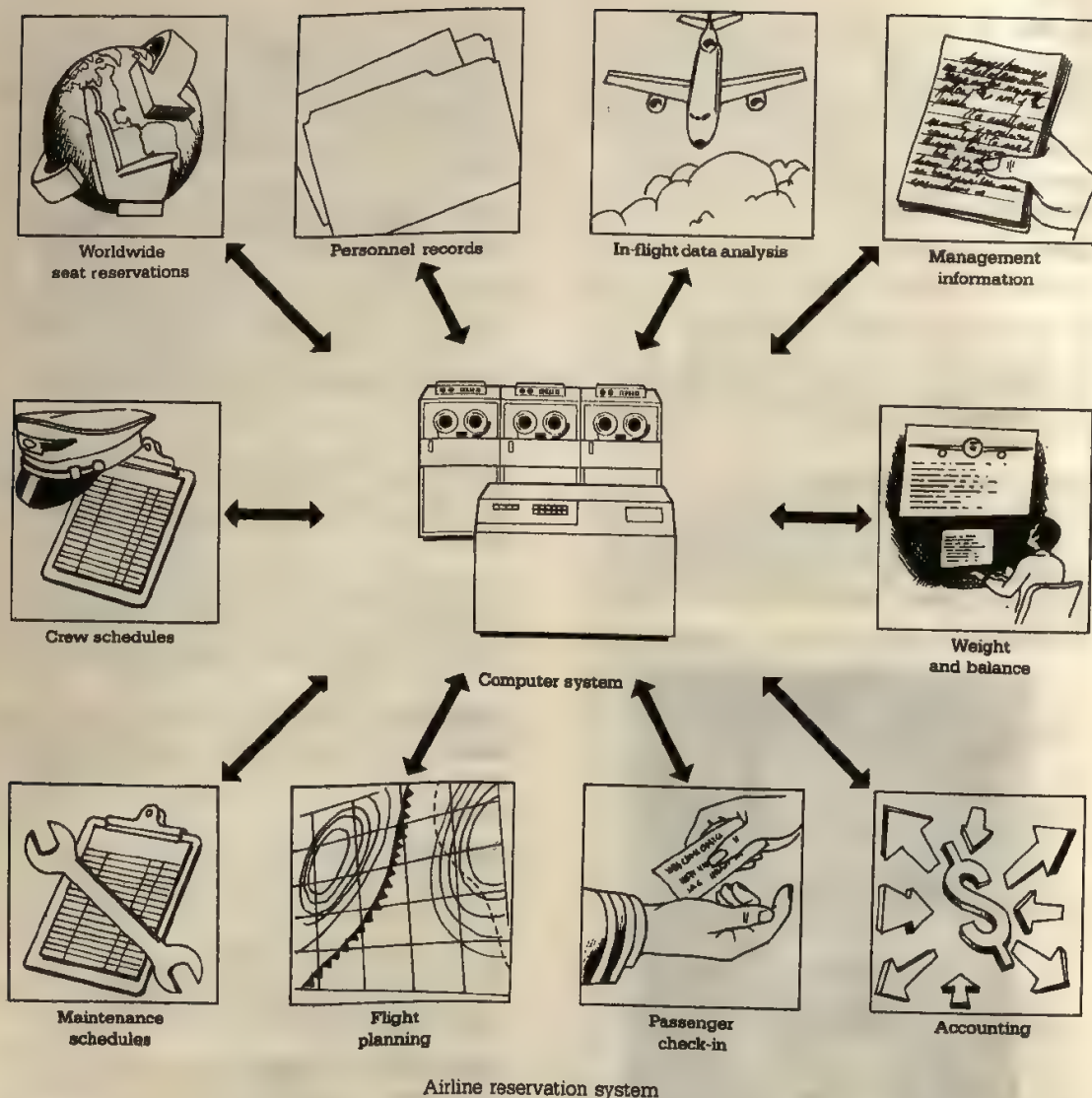
**alias** User-supplied name interpreted by the system to represent a program or command.

**aliasing** Undesirable visual effects in computer-generated images caused by improper sampling techniques. Most common effect is a jagged edge along object boundaries.

**aligning edge** That edge of a form that, in



## alignment



conjunction with the *leading edge*, serves to position correctly a document to be scanned by an OCR device. Also called reference edge.

**alignment** Adjustment of tolerances within the mechanism of a device so it will operate properly.

**allocation** Process of reserving computer storage areas for instructions or data. Some-

times done by a programmer, or sometimes automatically by a program. Opposite of *deallocation*.

**alpha** Alphabetic characters A-Z.

**alphabetic string** String in which the characters are letters, or pertain to an agreed alphabet set.



**alphanumeric** Contraction of alphanumeric.

**alphanumeric** General term for alphabetic letters A-Z, numerical digits 0-9, and special characters—such as -, /, \*, \$, (, ), +, and — that are machine processable.

**alphanumeric display terminal** Device for entering alphanumeric information into a computer system and displaying it on a screen.

**alphanumeric sort** Process in which a computer system puts a list into alphabetical or numerical order, or both.

**alpha testing** Trying a new product out on the employees of one's own company before subjecting it to *beta testing*.

**Altair** First microcomputer with the *S-100 bus* connecting the printed circuit boards inside the computer. In 1974 the Altair 8800, first microcomputer in kit form, was offered for sale.

**alternating current (AC)** Electric current that reverses direction periodically, commonly 50 or 60 times per second. Contrast with *direct current*.

**ALU** Acronym for *Arithmetic-Logic Unit*, the portion of the central processing unit where arithmetic and logical operations are performed.

**ambient conditions** Environmental conditions that surround a computer system, such as light, temperature, and humidity.

**ambient temperature** Temperature surrounding a piece of equipment.

**Amdahl, Gene** Designer of several early IBM computers. Created an architectural revolution in designing the IBM System/360 computer series in 1964, the first computer to use integrated circuits. An early promoter of the concept of hardware compatibility, he later designed several computers for the Amdahl Corporation.

**American Federation of Information Processing Societies (AFIPS)** Organization rep-

resenting computer science and data processing organizations. Activities include sponsorship of the annual *National Computer Conference* (largest computer convention in the world), and committee work on education, research, government activities, standards and practices, and the history of computing. American representative of the *International Federation for Information Processing (IFIP)*.

**American National Standards Institute (ANSI)** Organization that acts as a national clearinghouse and coordinator for voluntary standards in the United States.

**American Society for Information Science (ASIS)** Professional organization that provides a forum for librarians, information specialists, and scientists who seek to improve the communication of information. Members are highly educated, involved administrators, managers, coordinators, information technologists, and scientists who work in systems analysis and design; manage information programs and services; search, prepare, and analyze information; market information programs, services, and databases; consult; and program.

**American Standard Code for Information Interchange** See *ASCII*.

**American Statistical Association (ASA)** International organization whose goals are to further the development of statistics, founded in 1839. Fosters statistical standards in research and applications to ensure the quality of techniques used for decision making and forecasting. Through exchange in professional knowledge and reporting of developments, statistical methods in one field are made known to workers in others. Prepares students for entry into business and industry by participating in the quality of statistical training.

**Amiga** Popular microcomputer system manufactured by Commodore International, Inc.

**ampere** Base SI unit of electric current. A current of 1 ampere means that  $6.25 \times 10^{18}$



## **amplifier**

electrons are flowing by a point each second; 1 ampere equals 1 coulomb per second.

**amplifier** Electronic circuit that increases the voltage, current, or power of an input signal, or that isolates one part of a system from another.

**analog** Pertaining to representation by means of continuously variable physical quantities. Contrast with *digital*.

**analog computer** Computer that measures continuously changing conditions, such as temperature and pressure, and converts them into quantities. Contrast with *digital computer* and *hybrid computer system*.

**analog data** Physical representation of information such that the representation bears an exact relationship to the original information. Electrical signals on a telephone channel are analog data representations of the original voice data. Contrast with *digital data*.

**analogical reasoning** Drawing conclusions about a system by studying a model of it.

**analog model** Model that relates physical similarity to the actual situation.

**analog representation** Representation that does not have discrete values but is continuously variable.

**analog signal** Signal that varies continuously in wave form, such as the human voice.

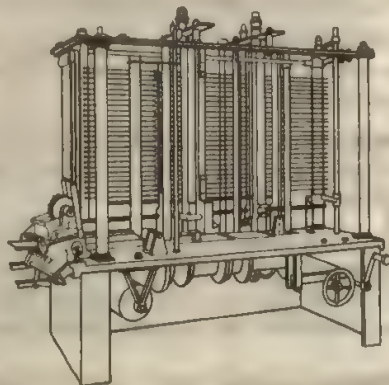
**analog-to-digital converter (A-D converter)** Mechanical or electrical device used to convert continuous analog signals to discrete digital numbers. Opposite of *digital-to-analog converter*. See *digitize*.

**analog transmission** Transmission of data as continuous wave patterns.

**analyst** Person skilled in the definition and development of techniques for solving a problem, especially those techniques for solutions on a computer. See *programmer/analyst* and *systems analyst*.

**analyst/programmer** See *programmer/analyst*.

**analytical engine** Device invented in the mid-1800s by Charles Babbage, a British mathematician, to solve mathematical problems. A forerunner of the modern digital computer. See *Babbage, Charles*.



Analytical engine

**AND** Logical connector, as in the statement A AND B, which means that the statement is true if, and only if, both A and B are true simultaneously. Also called logical multiply. Contrast with *OR*. Compare *NAND*, *NOR*, and *XOR*.

**AND gate** (1) Binary circuit with two or more inputs and a single output, in which the output is logic one only when all inputs are logic one, and the output is logic 0 if any one of the inputs is logic 0. (2) In a computer, a gate circuit with more than one input terminal. No output signal will be produced unless a pulse is applied to all inputs simultaneously. Contrast with *OR gate*.

**android** Humanlike male robot. See *gynoid*.

**angstrom** Unit of measurement, 1/250 millionth of an inch. Used to measure the elements in electronic components on a chip.

**animation** Process of making an object ap-



pear to move by rapidly displaying a series of pictures of it, each one in a slightly different position. Technique used for producing computer-generated movies



Animation

**annotation symbol** Symbol used to add messages or notes to a flowchart, attached to other flowcharting symbols by dashed lines

**ANSI** Acronym for American National Standards Institute

**answer mode** Ability of a modem to accept an incoming call from another modem. See *originate/answer*

**answer/originate** In telecommunications, the alternatives of receiving (answering) or sending (originating) a phone call

**anthropomorphism** Figure of speech used to describe computers, and devices controlled by computers, as though they were persons

**anti-aliasing** Filtering technique to give the appearance of smooth lines and edges in a raster display image

**antistatic mat** Floor mat placed in front of a device, such as a disk unit, that is sensitive to static, to prevent shocks that could cause loss of data during human handling of the unit

**aperture card** Punched card with an opening specifically prepared for the mounting of a frame or frames of microfilm

**APL** Acronym for A Programming Language, a mathematically structured programming language, popular for problem-solving applications. In its simplest mode of operation, APL performs the functions of an intelligent calculator. The power of the language is demonstrated by its extended single operators that allow a user to perform directly such calculations as taking the inverse of a matrix or solving a set of linear equations. (See page 10.)

**append** Add on, such as to add new records to a database or to add to the end of a character string or list

**Apple** Brand name for a series of microcomputers manufactured by Apple Computer, Inc.

**Applesoft BASIC** Extended version of the BASIC programming language used with Apple IIc and IIe computers and capable of processing numbers in floating-point form. An interpreter for creating and executing programs in Applesoft BASIC is built into the computer.

**application** Task to be performed by a computer program or system. Broad examples of computer applications are engineering design, numerical control, airline seat reservations, business forecasting, and hospital administration. Accounts receivable, mailing list, or electronic spreadsheet programs are examples of applications that run on small business computers.

**application-oriented language** Problem-oriented programming language whose statements contain or resemble the terminology of the computer user.

**applications programmer** Computer programmer who develops applications programs. Contrast with *system programmer*.

**applications programming** Preparation of programs for application to specific problems to find solutions. Contrast with *systems programming*.

**applications programs** Programs normally



```

▽SALES1
[1] 'ENTER P'
[2] P←□
[3] 'ENTER S'
[4] S←3 S←□
[5] J←1
[6] TOTAL←+/P×S[;J]
[7] 'TOTAL SALES FOR SALESMAN ;J;' IS 'TOTAL
[8] →S× ,5>J←J+1
▽

```

SALES1

ENTER P

□:

1.25 4.30 2.50

ENTER S

□:

40 20 37 29 42 10 16 3 21 8 35 47 29 16 33  
TOTAL SALES FOR SALESMAN 1 IS 180.5  
TOTAL SALES FOR SALESMAN 2 IS 211.3  
TOTAL SALES FOR SALESMAN 3 IS 131.65  
TOTAL SALES FOR SALESMAN 4 IS 166.35  
TOTAL SALES FOR SALESMAN 5 IS 169.4

APL

written by programmers within an organization that enable the computer to produce useful work, such as specific inventory control, attendance accounting, linear programming, or medical accounting tasks. Contrast with *systems programs*.

**applications software** See *applications programs*.

**applied mathematics** Mathematics put to practical use, as in mechanics, physics, or computer science.

**apprentice** Simple expert system that helps a human expert resolve complex technical questions, step by step. Applications are in oil exploration, locomotive repair, and medical diagnosis.

**approximation** Number that is not exact, but has been rounded off to a prescribed decimal place: 3.14 and 3.14159 are both approximations of pi. See *accuracy*.

**APT** Acronym for Automatic Programmed Tool, a programming system used in numerical control applications for the programmed control of machine functions. APT allows a user to define points, lines, circles, planes, conical surfaces, and geometric surfaces. See *numerical control* and *parts programmer*.

**arcade game** Computer video games popularized by coin-operated machines, characterized by high-resolution color graphics, high-speed animation, and sound. Players often use joysticks to control a screen object, and the computer scores points based on the game's rules. See *computer game* and *computerized game playing*.

**architecture** Physical structure of a computer's internal operations, including its registers, memory, instruction set, and input/output structure.

**archival** Pertaining to long-term storage of data.



```

PARTNO APT LANGUAGE EXAMPLE **
MACHIN/GECENT,2 **
INTOL/.0005 **
OUTTOL/.0005 **
SEPT  =POINT/-1,-1,0
FROM/SETP **
SPINDLE/2600,ON **
COOLNT/ON **
FEDRAT/30 **
CUTTER/.5 **
GO/(L1=LINE/0,0,10,0),(PLANE/0,0,1,0),(L2=LINE/0,0,0,10) **
TLRGT,GORGT/L1 **
GOLFT/(L3=LINE/PARLEL,L2,XLARGE,5) **
GOFWD/(C1=CIRCLE/CENTER,(POINT/3,2),TANTO,L3) **
GOLFT/(LINE/(POINT/YSMALL,INTOF,L2,C2),(POINT/CENTER,C2) **
GOLFT/L2,PAST,L1 **
GOTO/SETP **
STOP **
FINI

```

## APT

**archive** (1) To copy programs and data onto an auxiliary storage medium, such as disk or tape, for long-term retention. (2) To store data for anticipated normal long-term use

**area search** Examination of a large group of documents to select those that pertain to one group, such as a specific category or class.

**argument** Variable to which either a logical or a numerical value may be assigned.

**arithmetic** (1) Branch of mathematics concerned with study of the positive real numbers and zero. (2) Pertaining to such operations as addition, subtraction, multiplication, and division, or to the section of the computer hardware that performs these operations. See *arithmetic-logic unit* and *order of operations*.

**arithmetic expression** One or more numbers, variables, functions, symbols, or any combination of these that represents a single value in an arithmetic operation or function.  $(3 + 48)/$

$17, A + 10, X * Y - 82,$  and  $6$  are all arithmetic expressions. Contrast with *equation*.

**arithmetic-logic unit** Basic element of the central processing unit where arithmetic and logical operations are performed.

**arithmetic operation** Various manipulations of numerical quantities, including the fundamental operations of addition, subtraction, multiplication and division, as well as aggregation, exponentiation, and extraction of roots. See *order of operations*.

**arithmetic operator** Symbol that tells a computer to perform addition, subtraction, multiplication, division, aggregation, or raising to a power—which, with negative powers, is tantamount to extracting roots. See *order of operations*.

**arithmetic shift** To multiply or divide a quantity by a power of the *number base*. For example, if binary 1101, representing decimal



## arithmetic unit

13, is arithmetically shifted twice to the left, the result is 110100, representing 52, which is also obtained by multiplying 13 by 2 twice. however, if decimal 13 is shifted to the left twice, the result would be the same as multiplying by 10 twice, or 1300.

**arithmetic unit** Same as *arithmetic-logic unit*.

**ARPANET** Acronym for Advanced Research Projects Agency NETWORK, a government computer network that links Department of Defense sites, research centers, and computer think tanks. Goals are to permit computer resource sharing, develop highly reliable and economic digital communications, and enable access to unique and powerful facilities that become economically feasible when widely shared.

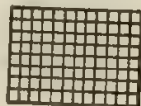
**ARQ** Acronym for Automatic Repeat reQuest, a *data transmission* checking function.

**arrangement** Order of index terms or items of data in a system.

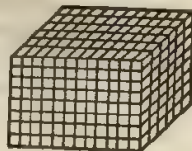
**array** (1) Series of related items. (2) Ordered arrangement or pattern of items or numbers, such as a determinant, *matrix*, *vector*, or table of numbers. See *one-dimensional array* and *two-dimensional array*.

One-dimensional array : 

Two-dimensional array



Three-dimensional array



Array

**array processor** Processor that performs *matrix* arithmetic much faster than standard com-

puters. Capable of performing operations on all the elements in large matrices at one time.

**arrival rate** Number of characters or messages arriving over a data communications medium per unit of time. See *data transfer rate*.

**artificial intelligence (AI)** Branch of computer science that studies how smart a machine can be, which involves the capability of a device to perform functions normally associated with human intelligence, such as reason-

ing, learning, and self-improvement. See *heuristic learning*, *machine learning*, *Intellect*, and *McCarthy, John*.

**artificial language** Language based on a set of prescribed rules that are established prior to its usage. Contrast with *natural language*

**ARTSPEAK** Programming language designed to help inexperienced users produce computer drawings on digital plotters.

**ASA** Acronym for *American Statistical Association*.

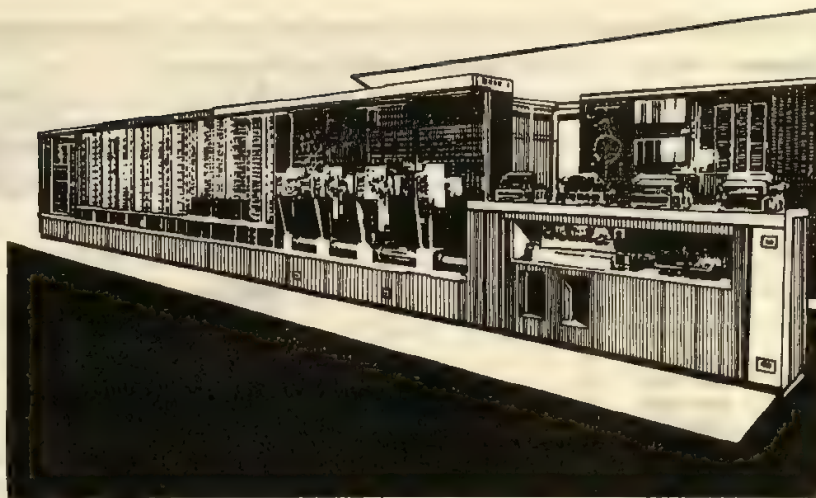
**ASCC** Acronym for Automatic Sequence Contolled Calculator, the first electromechanical computer, developed under the direction of Howard Aiken at Harvard University. Completed in 1944, it followed instructions stored on paper tape. Also called *HARVARD MARK I*.

**ascender** Portion of lower-case letters that extends above the main portion of the letter, such as the tops of b, d, and h. Also called kern. Contrast with *descender*.

**ascending order** Order that ranges from smallest to largest or first to last. Alphabets and counting numbers are in naturally ascending order. Contrast with *descending order*.

**ASCII** Acronym for American Standard Code for Information Interchange. Pronounced "ass-key." A 7-bit standard code adopted to facilitate interchange of data among various types of data processing and data communications equipment. Compare *EBCDIC*. (See page 14.)





ASCC (Automatic sequence controlled calculator)

**ASIS** Acronym for *American Society for Information Science*.

**ASM** Acronym for *Association for Systems Management*.

**aspect card** Card containing the accession numbers of documents in an information retrieval system.

**aspect ratio** In computer graphics, the relationship of the height and width of the video display screen frame or image area.

**ASR** Acronym for Automatic Send/Receive, a teletypewriter with keyboard, printer, paper tape reader, and paper tape punch that allows tape to be produced and edited offline for automatic transmission.

**assemble** To gather, interpret, and coordinate data required for a computer program, translate the data into computer language, and project it into the final program for the computer to follow.

**assembler** Computer program that takes nonmachine-language instructions prepared by a computer user and converts them into a form that may be used by the computer. Computer

program that *assembles*. Contrast with *disassembler*. (See page 14.)

**assembler directive** Statement placed in an assembly language program to give directions to the assembler.

**assembling** Automatic process by which a computer converts a symbolic source-language program into a machine language, usually on an instruction-by-instruction basis. See *cross compiling/assembling*.

**assembly language** Programming language that allows a computer user to write a program using mnemonics instead of numeric instructions. A low-level symbolic programming language that closely resembles machine-code language. Same as *low-level language*. Contrast with *problem-oriented language* and *procedure-oriented language*. (See page 15.)

**assembly listing** Printed output produced by an assembler. Lists the original assembly-language program, the machine-language version of the program, storage assignments, error messages, and other information useful to the programmer. (See page 15.)



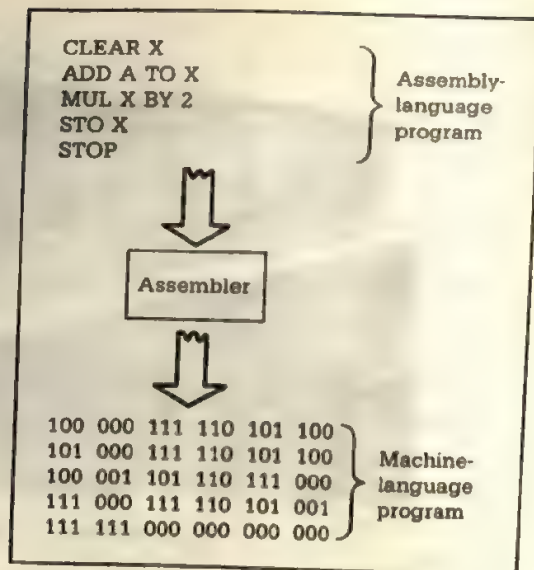
## assignment statement

Character	ASCII
0	011 0000
1	011 0001
2	011 0010
3	011 0011
4	011 0100
5	011 0101
6	011 0110
7	011 0111
8	011 1000
9	011 1001
A	100 0001
B	100 0010
C	100 0011
D	100 0100
E	100 0101
F	100 0110
G	100 0111
H	100 1000
I	100 1001
J	100 1010
K	100 1011
L	100 1100
M	100 1101
N	100 1110
O	100 1111
P	101 0000
Q	101 0001
R	101 0010
S	101 0011
T	101 0100
U	101 0101
V	101 0110
W	101 0111
X	101 1000
Y	101 1001
Z	101 1010

ASCII

**assignment statement** Source language statement that makes an assignment.

**Association for Computers and the Humanities (ACH)** An international organization devoted to the encouragement of computer-aided research in language and literary studies, history, anthropology, and related social sciences as well as the use of computers in the creation and study of art, music, and dance.



Assembler

## Association for Computing Machinery (ACM)

World's largest educational and scientific society committed to the development of technical skills and professional competence of computer specialists. Founded in 1947, ACM has earned a reputation for technical excellence by publishing prestigious journals and sponsoring numerous conferences that promote an ongoing dialogue among students, educators, and practitioners. Over 62 000 members.

## Association for Educational Data Systems (AEDS)

Private, nonprofit educational organization that serves educators and data processing professionals at all levels in education. Provides a forum for exchange of ideas and information about the relationship of modern technology to modern education. Has an annual conference; national, regional, and local workshops; and an annual computer programming contest for secondary school students. Quarterly publications are *AEDS Bulletin*, *AEDS Journal*, and *AEDS Monitor*.

## Association for Systems Management (ASM)

An international organization engaged



ASSEMBLY LANGUAGE CODING FORM				
LOCATION	OPERATION	OPERAND 1	OPERAND 2	COMMENTS
BEGIN	LD	REG 3	C	LOAD C INTO REGISTER 3
	MUL	REG 3	B	MULTIPLY REGISTER 3 BY B
	ADD	REG 3	A	ADD A TO REGISTER 3
	STR	REG 3	D	STORE REGISTER 3 AT D

Assembly language

000100 05 F0

```

000102 5B 30 F 012
000106 5A 30 F 016
00010A 5B 30 F 01A
00010E 5D 30 F 01E
000112 DA D0
000114 00000009
00011B 00000004
00011C 00000006
000120

```

000102

```

BEGIN START 256
BALR 15 0
USING *,15
L 3,OLDOH
A 3,RECPT
S 3,ISSUE
ST 3,NEWOH
SVC D
OLDOH DC F'9'
RECPT DC F'4'
ISSUE DC F'6'
NEWOH DS F
END BEGIN

```

Assembly listing

in keeping its members abreast of the rapid growth and change occurring in the field of systems management and information processing. Founded in 1947, it has five technical departments: Data Communications, Data Processing, Management Information Systems, Organization Planning, and Written Communications. Members can belong to one or more of these departments.

**Association for Women in Computing (AWC)** Nonprofit professional organization comprised of people who have an interest in the field of computer data processing. Main goals are to promote communication among, further the professional development and advancement of, and promote the education of women in computing.

**Association of Computer Programmers and Analysts (ACPA)** International organization of professionals that offers members a voice on professional issues plus opportunities to develop professional skills through seminars, workshops, and conferences. Provides informative national and chapter publications and promotes exchange of ideas with other professionals at chapter activities.

**Association of Data Processing Service Organizations (ADAPSO)** Association of commercial institutions that offers data processing services through systems that its members operate on their own premises. A directory is published annually.

**Association of Information Systems Professionals (AISP)** Organization of profes-

## associative storage

sionals involved in all aspects of information systems. Founded in 1972 as the International Word Processing Association, AISP now has more than 16 000 members worldwide with organized chapters in more than 100 metropolitan areas of the United States and Canada.

**associative storage** Storage device whose storage locations are identified by their contents (rather than by names or positions, as in most computer storage devices). Same as *content-addressable memory* and *search memory*.

**asterisk** Symbol (\*) used in many programming languages to represent a multiplication operator.

**asynchronous** Pertaining to a mode of data communications that provides a variable time interval between characters during transmission.

**asynchronous communications adapter** Device attached to a computer that enables it to effect asynchronous data communications over standard telephone facilities.

**asynchronous computer** Computer in which each operation starts as a result of a signal generated by the completion of the previous operation or by the availability of the equipment required for the next operation. Contrast with *synchronous computer*.

**asynchronous input** Input data having no time-dependable pattern or cycle when related to the computer system.

**asynchronous transmission** Method in which data characters are sent at random time intervals. Limits phone-line transmission to about 2400 bps. Contrast with *synchronous transmission*.

**Atanasoff-Berry Computer** First electronic digital computer, invented in 1939 by John Atanasoff and Clifford Berry. See *ABC*; *Atanasoff, John V.* and *Berry, Clifford*.

**Atanasoff, John V.** In 1939, with his assist-

ant Clifford Berry, invented the first electronic digital computer—the ABC (Atanasoff-Berry Computer). He was interested in finding faster ways of performing computations of math problems. See *ABC* and *Berry, Clifford*.

**Atari** Popular line of personal computers and peripheral equipment. Despite its Japanese name, the company is American and has been so since its inception.

**ATM** Acronym for *Automatic Teller Machine*.

**atom** Elementary building block of *data structures*. Corresponds to a record in a file and may contain one or more fields of data.

**attach** To connect a peripheral to a computer to increase its capacity.

**attenuation** Decrease in the strength of a signal as it passes through a control system. Opposite of *gain*.

**atto** Prefix meaning one quintillionth, or a billionth of a billionth;  $10^{-18}$  Abbreviated a.

**attribute** (1) Manner in which a variable is handled by the computer. (2) Characteristic quality of a data type, data structure, element of a data model, or system. (3) Feature of a device.

**audio** Sound that can be heard by a human.

**audio device** Any computer device that accepts sound and/or produces sound. See *voice recognition system* and *voice synthesis*.

**audio output** Computer output generated through voice synthesizers that create audible signals resembling a human voice. See *voice synthesis*.

**audio response device** Output device that produces a spoken response. See *voice output*.

**audiovisual** Pertaining to nonprint materials—such as films, tapes, and cassettes—that record information by sound and/or sight.

**audit trail** Means for identifying the actions taken in processing input data or in preparing



output. By use of the audit trail, data on a source document can be traced to a specific output, and an output can be traced to the source items from which it was derived. For example, it could reveal that Nancy Wilson changed the inventory figures in the Auto Supply account at 2:32 P.M. on October 8.

**authenticity** Integrity of a message.

**authoring system** Computer system capable of executing an *author language*.

**authorization** System control feature that requires specific approval before processing can take place.

**authorized program** Computer program capable of altering the fundamental operation or status of a computer system.

**author language** Programming language used for designing instructional programs for *computer-assisted instruction* systems. See *PILOT* and *PLANIT*.

A-19

```
10 T: NAME A COMMON HOUSEHOLD PET
20 A:
30 M: DOG, CAT, HAMSTER, RABBIT
40 TY: YES, THAT'S A COMMON PET
50 TN: NOT VERY COMMON
```

Author language

**authors** People who design instructional material for *computer-assisted instruction* systems.

**auto-answer** Modem that can automatically answer incoming telephone calls from computers and pipe the data into another computer. See *communications software*.

**autochart** Type of documentor used for the automatic production and maintenance of charts, principally flowcharts.

**auto-dial** Modem capable of connecting to the telephone system and dialing a number. The *modem* and *communications software* perform the proper communications procedures so that computers may exchange data.

**AUTODIN** Acronym for AUTOMATIC Digital Network, the data-handling portion of the military communications system.

**auto indexing** System of indexing that superimposes additional information at any of several given addresses

**auto-load** Key on some computer keyboards that activates the computer. Essentially boots the *operating system* into internal storage and starts execution of the system.

**automata** Theory related to the study of the principles of operation, behavioral characteristics, and application of automatic devices. See *Wiener, Norbert*.

**automated data processing** Largely self-regulating process in which information is handled with a minimum of human effort and intervention.

**automated flowchart** Flowchart drawn by a computer-controlled printer or plotter.

**automated office** Result of the merger of computers, office electronic devices, and telecommunications technology in an office environment. See *electronic office*.

**automated teller machine** See *automatic teller machine*.

**automatic** Pertaining to a process or device that, under specified conditions, functions without intervention by a human operator.

**automatic carriage** Control mechanism for a typewriter or printer that can automatically control the feeding, spacing, skipping, and ejecting of paper or preprinted forms.

**automatic check**

**automatic check** Equipment check built in specifically for checking purposes. Also called *built-in check*.

**automatic coding** Machine-assisted preparation of machine-language routines.

**automatic computer** Computer that can process a specified volume of work, its assigned function, without requiring human intervention except for program changes.

**automatic controller** Device or instrument capable of measuring and regulating by receiving a signal from a sensing device, comparing this data with a desired value, and issuing signals for corrective action.

**automatic error correction** Technique for detecting and correcting errors that occur in data transmission or within the system itself.

**automatic loader** Hardware loader program, usually implemented in a special ROM, that allows loading of an auxiliary storage unit (magnetic disk or tape). See *bootstrapping*.

**automatic message switching** See *message switching*.

**automatic programming** (1) Process of using a computer to perform some stages of the work involved in preparing a program. (2) Production of a machine-language computer program under the guidance of a symbolic representation of the program.

**automatic quality control** Technique for evaluating the quality of a product being processed by checking it against a predetermined standard, and then automatically taking the proper corrective action if the quality falls below the standard.

**automatic scrolling** Same as *continuous scrolling*.

**automatic shutdown** Ability of some systems software to stop a network or a computer system as a whole in an orderly fashion.

**automatic teller machine (ATM)** Banking terminal that provides customers with 24-hour

deposit-and-withdrawal service. Special-purpose device connected to the bank's computer system. To use the automatic teller, the customer inserts a plastic identification card, enters a special password code, and communicates with the system by using a numeric keypad and a visual display.



Automatic teller machine

**automation** (1) Implementation of processes by automatic means. (2) Automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human observation, effort, and decision. Compare *industrial robot* and *mechanization*.

**automaton** Machine designed to simulate the operations of living things.

**automonitor** (1) Computer's record of its functions. (2) Computer program that records the operating functions of a computer.

**autopilot** Device used to fly an airplane or space vehicle automatically.

**autopolling** Contraction of automatic polling.



a process whereby terminals in a computer network are scanned periodically to determine whether they are ready to send information. A combination of hardware and software that polls the terminals in a computer network.

**auto-redial** *Modem* feature for redialing a number until contact is established.

**auto-repeat** Feature of some keyboards that allows a key to repeat automatically when held down.

**auto-restart** Capability of a computer to perform automatically the initialization functions necessary to resume operation following an equipment or power failure.

**autoscore** In word processing, an instruction that causes text to be underlined.

**auxiliary equipment** Equipment not under direct control of the central processing unit. See *offline*.

**auxiliary function** In automatic machine tool control, a machine function other than the control of the motion of a work-piece or cutter. Control of machine lubricating and cooling equipment are typical auxiliary functions.

**auxiliary memory** See *auxiliary storage*.

**auxiliary operation** Operation performed by equipment not under control of the central processing unit. See *offline*.

**auxiliary storage** Storage that supplements the *main storage* of a computer, such as magnetic disks, floppy disks, and magnetic tapes. Same as *secondary storage*. Contrast with *internal storage*.

**availability** Ratio of the time that a hardware device is known or believed to be operating correctly to the total hours of scheduled operation. Often called *operating ratio*.

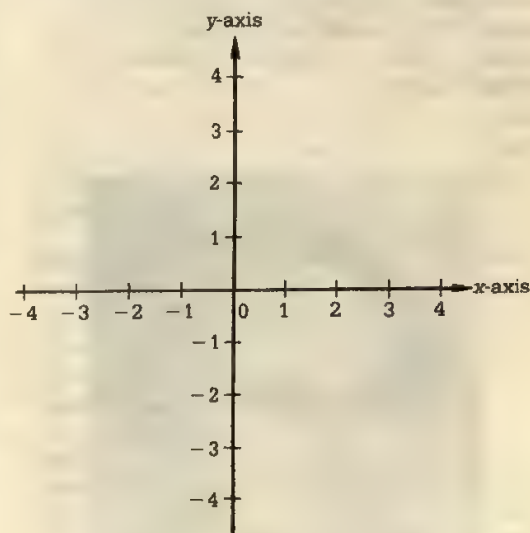
**available time** Time that a computer is available for use but is not being used. Contrast with *downtime* and *uptime*.

**average** Statistical or arithmetic mean.

**average search length** Anticipated time or number of functions to be performed to locate an address.

**AWC** Acronym for *Association for Women in Computing*.

**axes** In a two-dimensional coordinate system, lines used as references for vertical (Y) and horizontal (X) measurement. See *Cartesian coordinate system*.



Axes

# B

**B** Abbreviation for *byte* or *baud*. Used for bytes when referring to storage, or baud rate when referring to communications. KB = 1 000 bytes or baud (technically, 1K = 1 024 bytes).

**Babbage, Charles** (1792–1871) British mathematician and inventor. Designed a *difference engine* for calculating logarithms to 20 decimal places and an *analytical engine* that was a forerunner of the digital computer. Babbage was ahead of his time, and the engineering techniques of his day were not advanced enough to build his machines successfully. See *Stibitz, George*.



Charles Babbage

**babble** *Cross talk* from a large number of channels in a system.

**background** (1) In multiprogramming, the environment in which low-priority programs are executed. (2) That part of a display screen not occupied with displayed characters or graphics (foreground).

**background job** See *background program*.

**background noise** In optical scanning, electrical interference caused by such things as ink tracking or carbon offsetting.

**background processing** Execution of lower-priority computer programs during periods when system resources are not required to process high-priority programs. See *background program*. Contrast with *foreground processing*.

**background program** Program that can be executed whenever the facilities of a multiprogramming computer system are not required by other programs of higher priority. Contrast with *foreground program*.

**backing store** Backup memory to the computer main memory. More commonly called *auxiliary storage*.

**backing-up** Making backup copies of files to prevent loss of their contents in the event the originals are damaged or lost.

**backlash** In a mechanical operation, the "play" between interacting parts, such as two gears, as a result of tolerance.



**back panel** Back of a computer case, with a number of sockets for connecting peripheral devices to the computer.

**backplane** Circuitry and mechanical elements used to connect the boards of a system. Main circuit board of a computer into which other circuit boards are plugged. Also called *motherboard* and *system board*.

**backspace** Keyboard operation that moves the cursor one place to the left. Allows modification of what has already been typed before it is entered into the computer.

**backspace tape** Process of returning a magnetic tape to the beginning of the preceding record.

**backtracking** Operation of scanning a list in reverse.

**backup** (1) Pertaining to procedures or *stand-by equipment* available for use in the event of failure or overloading of the normally used procedures or equipment. (2) To make a copy of a program or data in case the original is lost, damaged, or otherwise inaccessible. See *fail-safe system*, *fail-soft system*, *fall-back*, and *father file*.

**backup copy** Copy of a file or data set kept for reference in case the original file or data set is destroyed.

**backup programmer** Programmer who is an assistant to the *chief programmer*.

**Backus, John** In 1957, at the IBM Corporation, developed the computer language FORTRAN (FORmula TRANslator), a high-level programming language used to perform mathematical, scientific, and engineering computations.

**Backus Normal Form (BNF)** Notation for describing the *syntax* of programming languages. See *metalanguage*.

**backward chaining** Goal-driven method of reasoning that proceeds from the desired goal

to the facts already known. Contrast with *forward chaining*.

**backward read** Feature available on some magnetic tape systems whereby magnetic tape units can transfer data to computer storage while moving in reverse.

**badge reader** Terminal equipped to read credit cards or specially coded badges.

**bad sector** Sector on a disk that will not read or write correctly. Usually due to a physical flaw in the disk.

**Baldwin, Frank Stephen** In 1875, invented the first practical reversible four-process calculator in the United States.

**ball printer** Printer that has the printing elements on the face of a ball-like replacement element. Type fonts can easily be changed by changing the *typeball*.

**band printer** Impact printing device that uses a steel band or polyurethane belt to carry the character set. Can produce multiple carbon copies at speeds ranging from 300 to 2 000 lines per minute.

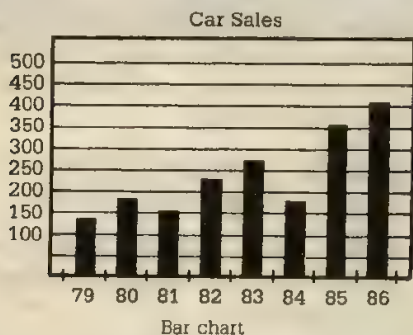
**bandwidth** In data communications, difference between the highest and lowest frequencies of a band. Used as a measure of the capacity of a communication channel, expressed in bits per second, or bauds. See *broadband*, *narrowband*, and *voice-grade*.

**bank** (1) In communications, a range of frequencies, as between two specified limits. (2) Range, or scope, of operation. (3) Group of circular recording tracks on a storage device such as a disk or drum.

**banked memory** Method of enlarging the usual 64K RAM memory. Space addressable by 8-bit microprocessors to a much larger range, usually to 1 megabyte. To avoid addressing confusion, boards above 64K are switched on by software control only when needed.

## bar chart

**bar chart** Widely used chart in business graphics. Used to display a time schedule.



**bar code** Code used on labels to be read by a scanner. Bar codes are used to identify retail sales items, library books, and railroad cars. See *Universal Product Code*.

**bar-code scanner** Optical device that can read data from objects bearing characters recorded in the form of parallel bars. The characters are translated into digital signals for storage or processing.



Bar-code scanner

**bare board** Printed circuit board with no electronic components on it.

**bar printer** Impact printing device that uses several type bars positioned side by side across the line.

**base** (1) *Radix* of a number system. (2) Region between the *emitter* and *collector* of a junction *transistor* that receives minority carriers ejected from the emitter. (3) On a printed circuit board, the portion that supports the printed pattern.

**base address** Specified address that is combined with a *relative address* to form the *absolute address* of a particular storage location.

**baseband transmission** Method of using low-frequency transmission of signals across coaxial cables for short-distance, local area network transmission.

**base 8** See *octal*.

**baseline document** Reference document for changes to a data processing system.

**base 16** See *hexadecimal*.

**base 10** See *decimal*.

**base 2** See *binary*.

**BASIC** Acronym for Beginner's All-purpose Symbolic Instruction Code, an easy-to-learn, easy-to-use, algebraic programming language with a small repertory of commands and simple statement formats. Developed at Dartmouth College by John Kemeny and Thomas Kurtz. Widely used in programming instruction, in personal computing, and in business and industry. Has been implemented on most microcomputers, minicomputers, and many larger machines. See *advanced BASIC*, *BASIC-PLUS*, *integer BASIC*, *floating point BASIC*, *True BASIC*, *Kemeny, John, and Kurtz, Thomas*.

**Basic FORTRAN** One of two approved American Standard versions of the *FORTRAN* programming language.

**basic linkage** Linkage used repeatedly in one routine, program, or system that follows the same set of rules each time. See *calling sequence* and *linkage*.

**BASIC-PLUS** Extension of the *BASIC* programming language. Includes more powerful capabilities, especially for data manipulation.



```

100 REM *** COMPOUND INTEREST ***
110 REM *** P - PRINCIPAL ***
120 REM *** I - YEARLY INTEREST RATE ***
130 REM *** N - NUMBER OF YEARS - LOOPING COUNTER ***
140 REM *** A - AMOUNT (PRINCIPAL + INTEREST) ***
150 REM *** CALCULATE VALUES FOR 5 - 20 YEARS ***
160 LET P = 2000
170 LET I = 5
180 FOR N = 5 TO 20
190     LET A = P * (1 + I/100)^N
200     PRINT "IN" ; N ; "YEARS, THE AMOUNT WILL BE" ; A
210 NEXT N
220 END

```

## BASIC

**batch** (1) Group of records or programs considered as a single unit for processing on a computer. (2) To use *batch processing*.

**batch processing** (1) Technique by which programs to be executed are coded and collected together for processing in groups or batches. The user gives the job to a computer center, where it is put into a batch of programs and processed, and then returned. The user has no direct access to the machine. See *remote batch processing*. (2) Processing as a group data that has been accumulated over a period of time or must be done periodically, as in payroll and billing applications.

**batch total** Sum of a set of items in a batch of records. Used to check the accuracy of operations involving the batch.

**Batten system** Method of indexing invented by W. E. Batten. Uses coordination of single attributes to identify specific documents. Sometimes called the *peek-a-boo system* because of its method of comparing holes in cards by superimposing cards and checking the coincidence of holes.

**battery backup** Auxiliary power provided to a computer so volatile information is not lost during a power failure.

**baud** Unit for measuring data transmission speed. One baud (B) is 1 bit per second. Since a single character requires approximately 8 bits to represent it, divide the baud rate by 8 to

calculate the characters per second (cps) to be transmitted. 300 baud = 37.5 cps, 1 200 baud = 150 cps, 2 400 baud = 300 cps. Most commercial information services (CompuServe, The Source, and Dow Jones News/Retrieval) offer both 300 and 1 200 baud.

**Baudot code** Code for the transmission of data in which five bits represent one character. Usually applied to the code used in many teleprinter systems. Also called International Telegraph Code Number 1. By 1950 this code had become one of the standards for international telegraph communications.

**Baudot, Emile** (1845–1903) Pioneer in printing telegraphy who invented the *Baudot code* in 1880.

**Baum, L. Frank** (1856–1919) Shared the turn-of-the-century optimism about machines as a positive force. An admired (but not beloved) character in his famous *Oz* series was Tiktok, the clockwork copper man who "was sure to do exactly what he was wound-up to do, at all times and in all circumstances."

**bay** Cabinet or rack in which electronic equipment is installed. Also called equipment bay.

**BCD** Acronym for *Binary Coded Decimal*.

**BCS** Acronym for British Computer Society, professional computer society in the United Kingdom.

**BDOS** Acronym for Basic Disk Operating System. In some operating systems, the part of the system that customizes it to a specific disk drive.

**bebugging** Intentional seeding of a program with known mistakes to measure the rates of debugging by student programmers.

**beep** Audible sound produced by a computer's speaker. Also a command in some programming languages which causes the computer's speaker to emit a sound. See *feep*.

**bell 103** Standard for 300-baud modems.

**bells and whistles** Informal description of the special or extra features of a computer system, including graphics, color displays, sound, and many peripherals.

**bell 212A** Standard for 1 200-baud modems.

**BEMA** Acronym for *Business Equipment Manufacturer's Association*.

**benchmark** Point of reference from which measurements can be made, such as use of a program to evaluate the performance of a computer. Any standard against which products can be compared.

**benchmark problem** Problem designed to evaluate and compare the performance of digital computers.

**benchmark tests** Tests used in the measurement of computer equipment performance under typical conditions of use, such as a computer program run on several different computers for the purpose of comparing execution speed, throughput, and so forth.

**Berry, Clifford** In 1939, with John Atanasoff, invented the first electronic digital computer—the ABC (Atanasoff-Berry Computer).

**beta testing** Pretesting of hardware and software products with selected "typical" users, to discover bugs before the product is

released to the general public. See *alpha testing*.

**bias** Amount by which the average of a set of values departs from a reference value.

**bibliography** (1) Annotated catalog of documents. (2) Enumerative list of books. (3) List of documents pertaining to a given subject or author. (4) Process of compiling catalogs or lists.

**bidirectional** Data flow may go in either direction on a wire. Transceivers at each end both receive and transmit. Common bidirectional buses are tristate or open collector transistor-transistor logic.

**bidirectional printer** Printer that prints from left to right as well as from right to left, avoiding carriage-return delay.

**bifurcation** Condition whereby two, and only two, outcomes can occur, such as on or off, 1 or 0, true or false.

**Big Blue** Nickname for International Business Machines Corporation (IBM), derived from the company's use of a distinctive blue paint on its computers and other equipment.

**BINAC** Acronym for BINary Automatic Computer, built by the Eckert-Mauchly Corporation in 1949.

**binary** Pertaining to the number system with a *radix* of 2, or to a characteristic or property involving a choice or condition in which there are exactly two possibilities. See *bifurcation*.

**binary arithmetic** (1) Mathematical numeration system equivalent to our decimal arithmetic system but involving only two digits: 1 and 0. (2) Expression recognizing that all arithmetic calculations are done with two values at a time.

**binary code** Coding system in which the encoding of any data is done through the use of bits, 0 or 1, in which 0 represents off and 1



represents on. *ASCII* and *EBCDIC* are two such systems.

**binary coded character** One element of a notation system representing alphanumeric characters—such as decimal digits, alphabetic letters, and special symbols—by a predetermined configuration of consecutive binary digits.

**binary coded decimal (BCD)** Computer coding system in which each decimal digit is represented by a group of four binary 1s and 0s. Contrast with *quibinary code*.

**binary coded decimal number** Any number, usually consisting of successive groups of figures, in which each group of four figures is a binary number that represents, but does not necessarily equal arithmetically, a particular figure in an associated decimal number; for example, the decimal number 264 is represented as the binary coded number 0010 0110 0100

7	5	2	1	3
0111	0101	0010	0001	0011

Binary coded decimal number

**binary device** (1) Device that can register two conditions, such as an electrical switch that can be on or off. (2) In computer science, equipment that records data in binary form or that reads the data so coded.

**binary digit** Either of the characters 0 or 1. Abbreviated *bit*.

**binary file** File containing programs in machine code.

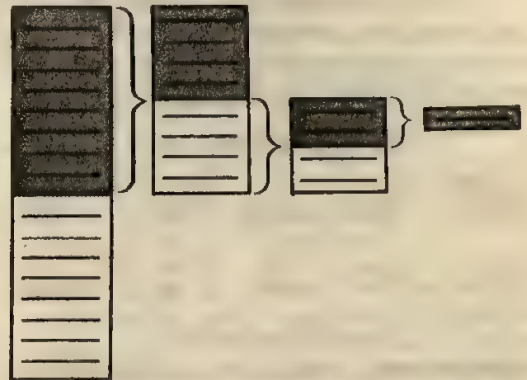
**binary notation** Numeral system written in base 2 notation.

**binary number** Any numeral, usually of more than one digit, expressing a sum in

which the quantity represented by each digit is based on a radix of 2. The digits used are 0 and 1.

**binary point** Radix point in a mixed binary numeral, separating the fractional part from the integer part. In the binary numeral 110.011, the binary point is between the two 0s.

**binary search** Search method in which a series of items is divided into two parts, one of which is rejected, and the process is repeated on each unrejected part until the item with the desired property is found. Often the best method when the list to be searched is known to be in order and relatively uniform. Many database systems use this method for locating items in their indexes.



Binary search

**binary system** Numeral system with a base or radix of 2. The numeral 111 in the binary system represents the quantity 1, plus  $1 \times 2^1$ , plus  $1 \times 2^2$ —that is, 7 in the decimal system.

**binary-to-decimal conversion** Process of converting a numeral written in base 2 to the equivalent numeral written in base 10

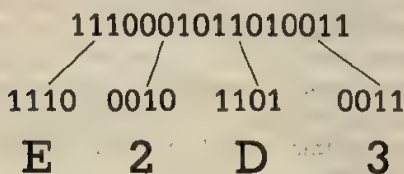
**binary-to-gray code conversion** The *gray code* equivalent of a binary numeral can be obtained by applying the following rule, reading from left to right: The most significant gray code digit equals the corresponding binary

## binary-to-hexadecimal conversion

digit, and the following gray code digit is 1 if the binary digit changes and 0 if it does not. For example, the binary value 0110100 equals the gray code value 0101110. Compare *gray code-to-binary conversion*.

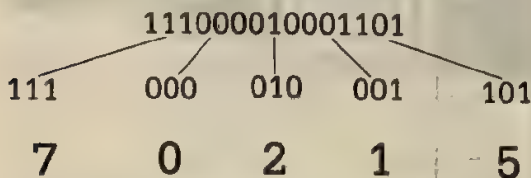
### binary-to-hexadecimal conversion

Process of converting a numeral written in base 2 to the equivalent numeral written in base 16.



Binary-to-hexadecimal conversion

**binary-to-octal conversion** Process of converting a numeral written in base 2 to the equivalent numeral written in base 8.



Binary-to-octal conversion

**binding time** Stage at which a compiler replaces a symbolic name or address with its machine-language form.

**biochip** Computer industry's attempt to turn living organisms into microchips. Some predictions call for a reduction in size by 500 times from current silicon chips, but other scientists say the chips could be 80 years in the making. Biochips are made from existing biosystems, such as large protein molecules, to produce electronic circuits and switches, or by synthesizing an electron-trained molecule from scratch. Futuristic process of creating organic microchips from protein and manufacturing genetically engineered bacteria.

**bionics** Study of living systems for the pur-

pose of relating their characteristics and functions to the development of mechanical and electronic hardware.

**BIOS** Acronym for Basic Input/Output System. In some operating systems, the part of the system that customizes it to a specific computer.

**bipolar** Pertaining to the most popular fundamental kind of integrated circuit, formed from layers of silicon with different electrical characteristics. Bipolar literally means "having two poles," unlike the earlier MOS Field Effect Transistor (MOSFET), which is unipolar ("having one pole"). As in MOSFET, the current flow of majority carriers goes in one direction only, such as from source to drain. In a bipolar transistor, the current in the *emitter* region splits and flows toward two terminals (poles), the *base* and the *collector*. Contrast with *unipolar*.

**bipolar read only memory** See BROM.

**biquinary code** A 7-bit weighted code used primarily to represent decimal numbers. A redundant code that may be used to provide error-checking features. A pair of bits represents the decimal number 5 or 0, and the remaining 5 bits are used to represent the decimal numbers 0 through 4.

**bistable device** Device with only two stable states, such as on and off.

**bi-state** Situation in which a computer component takes on one of only two possible conditions.

**bit** (1) Binary digit; a digit (1 or 0) in the representation of a number in binary notation. (2) Smallest unit of information recognized by a computer and its associated equipment. Several bits make up a *byte*, or a computer word.

**bit control** Means of transmitting serial data in which each bit has a significant meaning, and a single character is surrounded with start and stop bits.



**bit density** Measure of the number of bits recorded per unit of length or area on magnetic tape or disk.

**bit image** Collection of bits stored in a computer's memory, arranged into a rectangular matrix. The computer's display screen is a bit image that is visible to the user.

**bit manipulation** Act of turning bits on and off. Sometimes called bit-flipping.

**bit map** (1) Area in the computer's storage reserved for graphics. Holds the picture that is continuously transmitted to the display screen. (2) Array of bits whose on-off status corresponds to the status of an array of other things.

**bit-mapped screen** Screen display that associates each *pixel* on the screen with a memory location in the computer's RAM. Pixels are turned on or off depending upon the state of the memory location associated with each pixel.

**bit rate** Rate at which binary digits, or pulse representations, appear on communication lines or channels.

**bit-slice processor** Approach to microprocessors that allows microcomputer organizations of variable word sizes, with processor units separated into 2-, 4-, or 8-bit slices on a single chip. These devices can be paralleled to yield an 8-, 12-, 16-, 24-, or 32-bit microcomputer when assembled with the other necessary overhead components of the system.

**bit stream** Binary signal without regard to groupings by character.

**bit test** Program check to determine whether a specific bit is on (1) or off (0).

**bit transfer rate** Number of bits transferred per unit of time, usually expressed in bits per second.

**bit twiddler** (1) Hacker. (2) Person who enjoys working with computers.

**BL** Acronym for BLank, an empty space in text.

**black box** Electronic or mechanical device that alters input signals in a predictable manner but whose inner workings are often a mystery to the user.

**blank** (1) Part of a medium in which no characters are recorded. (2) In electronic spreadsheets, a command that will erase the contents of a cell or range of cells. (3) Empty space with dimension of one character of data.

**blank character** Character used to produce a character space on an output medium, generally denoted *b*.

**blanking** On a display screen, not displaying a character although it is present; leaving a space.

**blind search** Time-consuming type of search that uses an orderly scheme, but no prescience, to exhaust all possibilities.

**blinking** Graphics aid that makes a predefined graphic entity blink on the CRT to attract the designer's attention.

**block** (1) Group of digits, characters, or words that are held in one section of an input/output medium and handled as a unit, such as the data recorded between two interblock gaps on a magnetic tape. (2) Any number of *logical records* grouped as a single *physical record*.

**block diagram** Graphic representation of the logical sequence by which data is processed. See *flowchart*.

**block header** Brief record of data that describes a block of memory and its contents.

**blocking** Combining two or more logical records into one block, usually to increase the efficiency of computer input and output operations.

**blocking factor** Number of logical records per physical record on a magnetic tape or disk.

**block length**

**block length** Measure of the size of a block, usually specified in units such as records, words, characters, or bytes.

**block move** (1) Process in which a block of text is moved from one part of a document or file to another, or from one document or file to another. (2) In word processing, a feature that allows the user to identify a block of text and move it anywhere in a file. Electronic equivalent of "cut and paste."

**block sorting** Sorting technique used to break down a file into related groups.

**block structure** Programming concept that allows related declarations and statements to be grouped together.

**blocks world** Artificially created environment of blocks used in the study of robotics and natural language.

**block transfer** Relocation of an entire block of data from one area of storage to another.

**blow up** Unexpected halt to a program due to a bug or because it encounters data conditions it cannot handle.

**blue ribbon program** Computer program that executes properly on the first try and does not require any debugging.

**BMMC** Acronym for Basic Monthly Maintenance Charge.

**BNF** Acronym for *Backus Normal Form*.

**board** Short for printed circuit board. A flat, thin, rectangular component of a computer or peripheral that includes one or more layers of printed circuitry and to which chips and other electronic parts are attached. Sometimes called a *card*.

**board computer** Computer in which all electronic components are laid out on a single circuit board.

**board exchange warranty** Warranty that provides a customer with a new replacement board when the original needs repair.

**boilerplate** Pieces of text that get used over and over again, word for word, in different documents.

**boilerplate document** Document created by combining selected paragraphs from a set of standard paragraphs with a small amount of original information.

**boldfacing** Feature of some printers and word processing systems that lets them imitate the look of a boldface type font. On many printers, boldfacing is produced by *shadow printing*.

Who do you think **BOLD** will win the world series?

Boldfacing

**bold printing** Ability to make certain letters darker than the surrounding text. Some printers produce bold characters by *overstriking* or *shadow printing*.

**Bollee, Leon** Frenchman who in 1886, designed the first machine to perform multiplication successfully by a direct method instead of repeated addition.

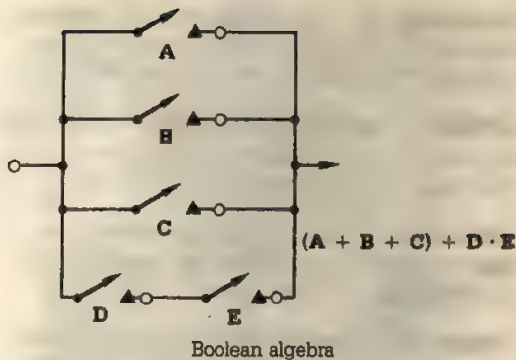
**bomb** (1) Spectacular failure in a program. See *crash*. (2) To sabotage a system by deliberately writing a program that will disrupt the system.

**bookkeeping** See *housekeeping*.

**Boolean algebra** Branch of symbolic logic similar in form to algebra, but dealing with logical relationships instead of numerical relationships. Lay dormant until it could be usefully applied to the fields of relay switching and electronic computers. Has now become an important subject in logic design of electronic computers. Named for George Boole.

**Boolean operator** Logic operator, each of whose operands and whose result has one of two values.





**Boole, George** (1815–1864) British logician and mathematician. In 1847, wrote a pamphlet called "Mathematical Analysis of Logic." In 1851, wrote a more mature statement of his logical system in a larger work, "An Investigation of the Laws of Thought," in which are founded the mathematical theories of logic. See *Boolean algebra*.

**boot** Derived from "bootstrap." To start or restart a computer system by *reading* instructions from a storage device into the computer's memory. Involves loading part of the operating system into the computer's main memory. If the computer is already turned on, it's a *warm boot*; if not, it's a *cold boot*.

**bootstrapping** Process of using a small initialization program bootstrap to load another program and to start up an inactive computer. See *boot*.

**bore** Diameter of a hole; such as on a floppy disk or magnetic tape reel.

**borrow** Arithmetically negative carry. It occurs in direct subtraction by raising the low-order digit of the minuend by one unit of the next higher-order digit.

**BOT** Acronym for Beginning Of Tape, a mark that shows where to start recording on a magnetic tape.

**bottleneck** See *limiting operation*.

**bottom-up technique** Implementation technique wherein the bottom-level modules are written and tested, after which the next-lowest level of modules are written and tested. This process continues until all of the modules have been completed. Contrast with *top-down development*.

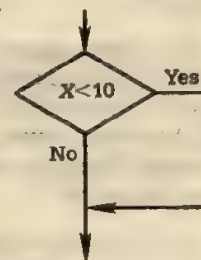
**bound** Pertaining to whatever limits system performance, such as *processor bound* or *I/O bound*, indicating which component of a system is the bottleneck preventing faster performance. See *limiting operation*.

**bpi** Abbreviation for bits per inch; sometimes *bytes per inch*, which is also abbreviated BPI.

**bps** Abbreviation for bits per second; sometimes *bytes per second*, which is also abbreviated BPS. 1 bps = 1 *baud*.

**brain-wave interface** Capability of hardware and software to enable the computer to read and act upon the thoughts of humans.

**branch** Selection of one or more possible paths in the flow of control, based on some criterion. Programming instruction that causes transfer of control to another program sequence. See *conditional transfer*, *jump*, and *unconditional transfer*.



Branch

**branch instruction** Instruction to a computer that enables it to choose between alternative program paths, depending upon the conditions determined by the computer during the execution of the program.

## branchpoint

**branchpoint** Place in a program where a branch is selected.

**breadboard** Experimental or rough construction model of a process, device, or construction.

**break** Interruption of a transmission. To interrupt execution of a program. Not synonymous with *control break*.

**break key** On some computers, a keyboard key that will interrupt what the computer is doing.

**breakpoint** Specified point in a program at which the program may be interrupted by manual intervention or by a control routine. Generally used as an aid in testing and debugging programs.

**bridge** Device that connects several data communication lines to form a multipoint circuit.

**bridgeware** Computer programs used to translate instructions written for one type of computer into a format that another type of computer understands.

**briefcase computer** *Portable computer* that will fit inside a briefcase. See *lap computer*, and *microcomputer*.

**brightness** (1) In computer graphics, the relative presence or absence of shading (whiteness to grayness to blackness). (2) On some CRT terminals, the ability to vary the intensity of the screen display. Especially useful in *highlighting* selected segments.

**broadband** Data communications transmission facilities capable of handling frequencies greater than those required for voice-grade communications. Broadband communication channels—such as microwaves, fiber optics, laser beams, and satellite transmission—can transmit data at rates up to five million baud. Contrast with *narrowband*.

**broadcast** In data communications, the dissemination of information to a number of stations simultaneously.

**BROM** Acronym for Bipolar Read Only Memory, a read only memory with no write function, that uses bipolar semiconductor devices.

**browsing** Looking at files or computer listings in search of something interesting, often without authorization to do so.

**brush** In computer graphics, a blob of color that can be moved anywhere on the display screen by means of a joystick, paddle, or similar input device. As the brush moves, it leaves behind a trail of color. See *paintbrush*.

**brute-force technique** Any mathematical technique that depends on the raw power of a computer to arrive at a nonelegant solution to a mathematical problem. Most computer users try to avoid brute-force techniques unless they have no practical alternative.

**BSC** Acronym for Binary Synchronous Communication, a procedure used for data transmission.

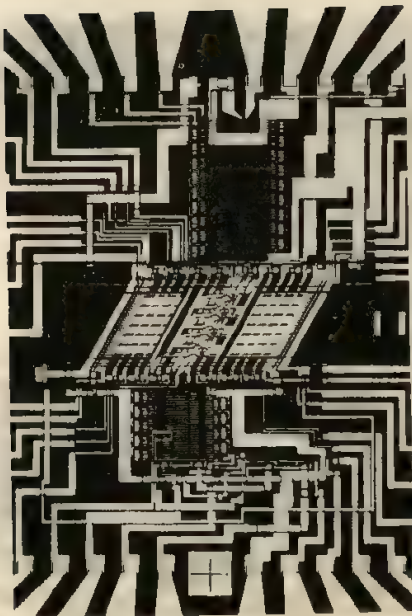
**BTAM** Acronym for Basic Telecommunications Access Method, an access method that permits read/write communications with remote devices.

**B-tree** Short for balanced tree, a way of organizing the pointers to information in databases that allows quick retrieval of any single specified record.

**bubble memory** Method by which information is stored as magnetized dots (bubbles) that rest on a thin film of semiconductor material. Offers a compact, nonvolatile storage capability. See *magnetic bubble memory*. Contrast with *volatile storage*.

**bubble sort** Sort achieved by exchanging successive pairs of keys until the list is ordered. Also called ripple sort. Compare *sifting*.



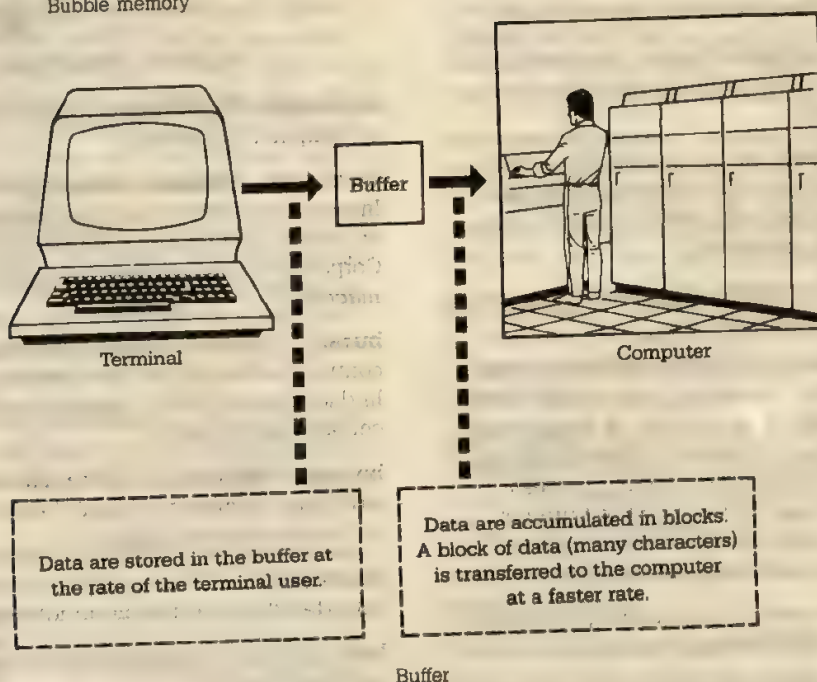


Bubble memory

**bucket** Specific portion of storage used to hold a group of records that are addressed jointly. Could be hardware-related or determined by *hashing*.

**budget forecasting model** Model generally used to consolidate budget information provided by separate departments by using standard accounting practices. May include capabilities to generate forecasts of cash flow, earnings per share, and other financial ratios resulting from performance according to budget. Such models are usually incorporated into *spreadsheet* programs.

**buffer** Temporary storage area used to equalize or balance different operating speeds. Can be used between a slow input device, such as a terminal keyboard, and the main computer, which operates at a very high speed. Compare *cache memory*



buffered computer

**buffered computer** Computer that provides for simultaneous input/output and process operations.

**buffering** Delaying and temporary storing of data in a data communications path.

**bug** Mistake in a computer program or system or a malfunction in a computer hardware component. To *debug* means to remove mistakes and correct malfunctions

**building block principle** System design that permits addition of other equipment units to form a larger system. See *modularity*.

**built-in check** See *automatic check*.

**bulk eraser** See *degausser*.

**bulk storage** Large-capacity data storage, generally long term. See *auxiliary storage*.

**bulletin board** Computer system that allows users to post messages or programs for other users. Also called *electronic bulletin board*.

**bundle** To include software, peripherals, and services as part of the purchase price of a computer system.

**bundled** Pertaining to inclusion by a computer manufacturer of the entire line of computer products and services in a single price. Contrast with *unbundled*.

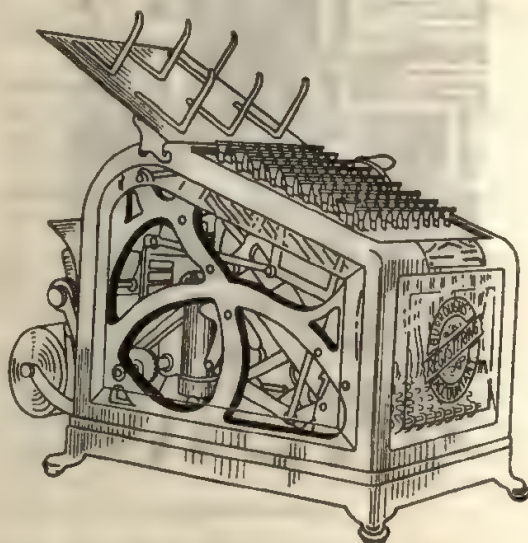
**burn** To ruin circuitry by subjecting it to excessive current or heat.

**burn-in** Process of testing electronic circuits and components by running the circuits at elevated temperatures in an oven. A typical test might be to run components continuously for a week at 50°C (122°F). This testing process causes weak links in the circuit to burn out; the failed circuitry is replaced with components that will withstand the test. See *fallout*.

**burning** Process of programming a read only memory. See *PROM programmer*.

**Burroughs' adding machine** First commercially practical adding-listing machine, invent-

ed in 1884 by William Burroughs. The keyboard and mechanism remain practically unchanged in some of today's manual machines. See *Burroughs*, *William Seward*.



Burroughs' adding machine

**Burroughs Corporation** Large manufacturer of computer equipment.

**Burroughs, William Seward** (1857–1898) Invented the first commercial adding machine, on which the fortune of the present Burroughs Corporation is based. See *Burroughs' adding machine*.

**burst** (1) In computer operations, to separate continuous-form paper into discrete sheets. (2) In data transmission, a sequence of signals counted as one unit.

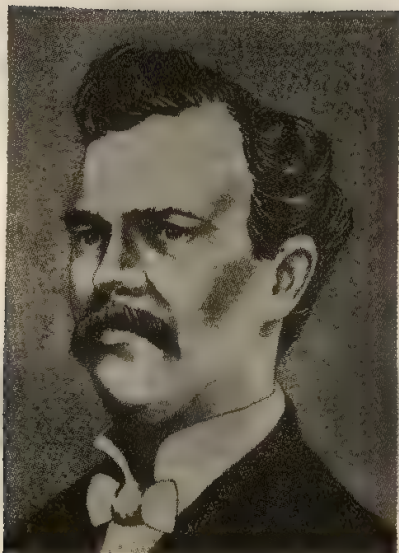
**burster** Mechanical device that takes apart a multipage computer printout. Separates copies and removes carbon paper.

**burst mode** Method of reading or writing data that does not permit an interrupt to occur.

**bus** Channel or path for transferring data and electrical signals.

**Bush, Vannevar** (1890–1974) Trying to solve





William Seward Burroughs

differential equations associated with power failures, he built, in 1930, the first automatic computer general enough to solve a wide variety of problems. Called a "differential analyzer," this forerunner of present-day analog computers weighed 100 tons and used thousands of vacuum tubes.

**business applications** Computer programs involving normal day-to-day accounting procedures such as payroll, accounts receivable, accounts payable, and inventory. See *business programming*. Contrast with *scientific applications*.

**business data processing** Data processing for business purposes, such as payroll, scheduling, and accounting. See *administrative data processing*.

**Business Equipment Manufacturers Association (BEMA)** Comprised of companies that manufacture computing equipment and office machines. Purposes are to guide users in solving problems and applying information for general benefit and to sponsor the establishment of standards for computers and informa-

tion processing equipment. Publishes a weekly news bulletin and an annual report.

**business graphics** (1) Pie charts, bar charts, scattergrams, graphs, and other visual representations of the operational or strategic aspects of a business, such as sales vs. costs, sales by department, comparative product performance, and stock prices. (2) Applications programs that allow the user to display data as visual presentations.

**business machines** Computers, word processing machines, terminals, and other electronic and mechanical equipment involved in business operations.

**business-oriented programming language** Language designed for handling large data files in business applications. See *COBOL*.

**business programming** Branch of computer programming in which business problems are coded for computer solution. Usually involves relatively few calculations but extensive files with a large number of data inputs and outputs. See *business applications*.

**business software** Programs specifically designed for business applications. Examples are electronic spreadsheets, database management systems, business graphics packages, payroll programs, and accounting programs.

**bus network** System in which all stations, or computer devices, communicate by using a common distribution channel, or bus. (See page 34.)

**bus system** Network of paths inside the computer that facilitate data flow. Important buses in a computer are identified as *data bus*, *control bus*, and *address bus*.

**bypass** Parallel path around one or more elements of a circuit.

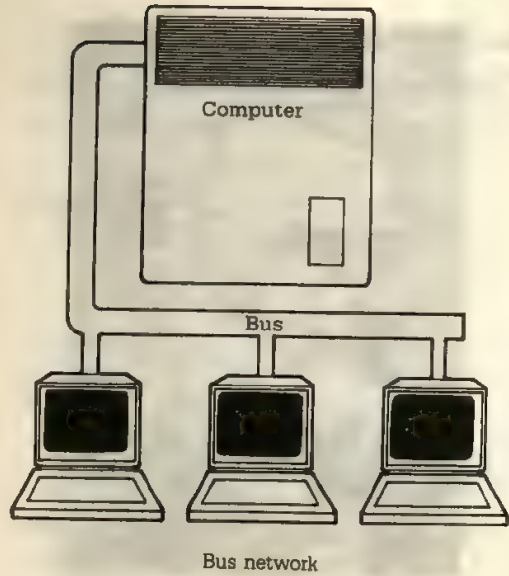
**bypass capacitor** Capacitor used to reduce electrical noise from the power supply.

**Byron, Ada** See *Lovelace, Ada Augusta*

## byte

**byte** (1) Grouping of adjacent binary digits operated on by the computer as a unit. The most common size byte contains eight binary digits. Compare *nibble*. (2) Group of binary digits used to encode a single character. Sometimes abbreviated B.

**bytes per inch (BPI)** Number of bytes that can be contained on one inch of magnetic tape. Common measure of recording *density*.





# C

**C** Full name of a programming language designed for use on microcomputers. Combines high-level statements with low-level machine control to deliver software that is both easy to use and highly efficient.

```
double inner (v1,v2,n)
double v1 ( ), v2 ( );
double sum;
int i;
sum = 0.0;
for (i=0; i<n; i++)
    sum = + V1(i), v2(i);
return (sum);
```

C

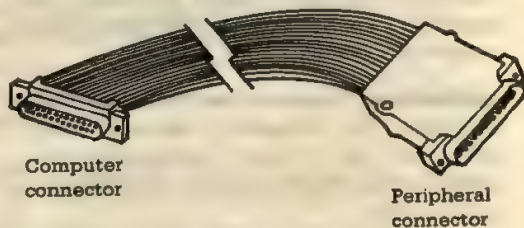
**cable** Electrical wire or bundle of wires used to connect two parts of the system together. Carries electrical power or electrical signals.

**cable connector** Male/female plug used for connecting cables between a computer and peripherals.

**cache memory** Small high-speed memory for the temporary storage of information, usually used between a slower large memory and a fast central processing unit. Also called *scratchpad*. Compare *buffer*.

**CAD** Acronym for *Computer-Aided Design*.

**CADAM** Acronym for *Computer-graphics*



Cable connector

Augmented Design And Manufacturing, the process of or methods for using computer systems as tools in design and manufacturing applications.

**CAD/CAM** Acronym for *Computer-Aided Design/Computer-Aided Manufacturing*.

**CAE** Computer-Aided Engineering; analyzes a design for basic error-checking, or to optimize manufacturability, performance, and economy. Information drawn from the CAD/CAM design database is used to analyze the functional characteristics of a part, product, or system under design, and to simulate its performance under various conditions.

**cage** See *card cage*

**CAI** Acronym for *Computer-Assisted Instruction*.

**CAL** Acronym for *Computer-Augmented Learning*.

**calculating** Reconstructing or creating new data by compressing certain numeric facts.

**calculations** Mathematical processes performed on data. See *arithmetic operation*.

## calculator

**calculator** Any mechanical or electronic machine used for performing calculations. Calculators, as distinguished from computers, usually require frequent human intervention. See *hand calculator*.

**calculator mode** Operating mode on some interactive computer systems that allows the terminal (or keyboard/display in the case of microcomputer systems) to be used as a desk calculator. The user types an expression; the computer then evaluates it and returns the answer immediately.

**calibration** Process of determining by measurement or by comparison with a standard the correct value of each scale reading on a meter or the correct value of each setting of a control knob.

**call** (1) To transfer control to a specific closed subroutine. (2) In communications, the action performed by the calling party, or the operations necessary in making a call, or the effective use made of a connection between two stations. Synonymous with *cue*.

**calligraphic graphics** Method of forming an image from scan lines oriented in arbitrary directions and drawn in an arbitrary order. Expensive electronics are required, but spatial *anti-aliasing* is not. Typical of this style of graphics are the "wire-frame" models that were considered synonymous with computer graphics in the early days.

**calling sequence** Specified set of instructions and data necessary to call a given subroutine.

**call instruction** Instruction that, after diverting execution to a new sequence of instructions (subroutine), permits return to the program's original sequence.

**CAM** Acronym for *Computer-Aided Manufacturing*.

**Canadian Information Processing Society (CIPS)** Organization formed to bring together Canadians with a common interest in the field

of information processing. Has a membership of over 4 000 scientists, businesspeople, and others who make their careers in computing and information processing.

**cancel** Keyboard operation that deletes the line currently being typed.

**canned software** Programs prepared by computer manufacturers or another supplier and provided to a user in ready-to-use form. General enough to be used by many businesses and individuals. Contrast with *custom software*.

**capacitance** Measure of the ability to store electric charge, the basic unit of measurement being a farad.

**capacitor** Electronic component that stores a charge of static electricity and, when properly stimulated, releases this charge. This is the way bits are written to and read from computer storage.

**capacitor storage** Storage device that utilizes the capacitance properties of materials to store data.

**capacity** Number of items of data that a storage device is capable of containing. Frequently defined in terms of computer words, bytes or characters.

**capstan** Rotating shaft within a magnetic tape drive that pulls the tape across the recording heads at a constant speed.

**capture (of data)** Recording of data on a form or its entry into a computer.

**carbon ribbon** Ribbon used with printers to produce extremely sharp characters with excellent definition.

**card** (1) Printed circuit board. (2) Storage medium in which data are represented by means of holes punched in vertical columns in an 18.7 cm by 8.3 cm (7  $\frac{3}{8}$  in. by 3  $\frac{1}{4}$  in.) paper card.

**card cage** Chassis inside the computer housing on which printed circuit boards are mounted.



**card code** Combinations of punched holes that represent characters in a punched card. See *Hollerith code*.

**card column** One of the vertical lines of punching positions on a punched card.

**card deck** Collection of punched cards.

**card face** Printed side of a punched card.

**card feed** Mechanism that moves punched cards into a machine one at a time.

**card field** Fixed number of consecutive punched-card columns assigned to a unit of information.

**card frame** Enclosure that holds a computer system's circuit boards in place.

**card hopper** Device that holds punched cards and makes them available for the feeding mechanism of card handling equipment.

**card image** Representation in storage of the holes punched in a card.

**card punch** Output device that accepts information from the computer's memory and punches it into cards. Compare *keypunch*.

**card punching** See *keypunching*.

**card reader** Input device that reads information punched into cards and transfers it into the computer's memory.

**card reproducer** Device that reproduces a punched card by punching a similar card. See *reproducing punch*. Not synonymous with *verifier*.

**card row** One of the horizontal lines of punching positions on a punched card.

**card sorting** Separating a deck of punched cards into stacks in accordance with the holes punched into the individual cards.


**card stacker** Receptacle into which cards are accumulated after passing through a punched card data processing machine.

**card-to-disk converter** Device that converts data directly from punched cards to disk storage.

**card-to-tape converter** Device that converts data directly from punched cards to magnetic or paper tape.

**card verification** Process of checking the accuracy of keypunching. A second operator verifies the original punching by depressing the keys of a verifier while reading the same source data. The machine compares the key depressed with the hole already punched in the card and, if they are not identical, indicates an error.

**caret** (1) Symbol used to indicate the location of the radix point of a number. (2)  $\wedge$  or  $>$  mark, used on a screen as a cursor to show where text should be inserted.

123.40  
Radix point 

Caret or radix point

**carousel** Rotary device that presents a data medium, such as film or microfilm, at an identified position for reading or recording.

**carriage** Control mechanism for a typewriter or printer that automatically feeds, skips, spaces, and ejects paper forms.

**carriage control key** Button that returns printer carriage to the start or home position.

**carriage control tape** Tape punched with information needed to control line feeding on a line printer.

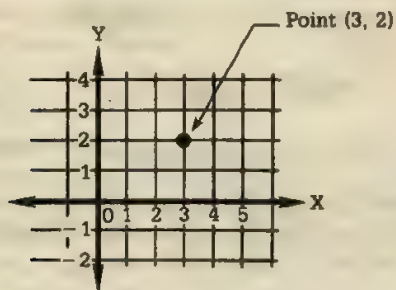
**carriage return (CR)** In a *character printer* the operation that causes the next character to be printed at the left margin.

**carrier frequency** Constant signal transmitted between communicating devices that is modulated to encode binary information.

**carry** (1) Process of bringing forward. Special condition that occurs when the sum of two digits in a single column is equal to or greater than the number base. (2) Carry digit, or the digit to be added to the next higher column.

**carry register** Register of one bit that acts as an extension of the *accumulator* during rotation or carry operations. Also called *link register*.

**Cartesian coordinate system** System named for French mathematician Rene Descartes whereby, in a flat plane, a point can be located by its distances from two intersecting straight lines, called the *axes*, the distance from one axis being measured along a parallel to the other axis. The numbers associated with the point are called the *coordinates* of the point. Also called *rectangular coordinate system*. Contrast with *polar coordinates*.



Cartesian coordinate system

**cartridge** Plug-in module that contains software permanently stored in ROM. Convenient, durable, easy to use, soundless, and non-erasable, a cartridge is inserted into a special slot built into the computer. Cannot be copied to disk or tape. Also called *solid state cartridge* and *ROM cartridge*.

**cascade connection** Two or more similar component devices arranged in tandem, with the output of one connected to the input of the next.

**cascade control** Automatic control system in which the control units are linked chain fashion,

each feeding into, as well as regulating, the next stage.

**cascade sort** External tape sort that sorts by merging strings from all but one tape onto the remaining tape. Subsequent passes merge fewer tapes until one tape contains all items.

**case logic** String of binary decisions, each testing for a value of the same variable.

**cashless society** Computerized system in which purchase transactions would be settled instantaneously by transferring credits from the buyer's bank account to the seller's account. No cash would ever be exchanged, with EFT deposits replacing paychecks as well as payments for goods and services.

**cassette** Small, self-contained volume of magnetic tape used for data storage.

**cassette interface** Circuitry used to control data communications between a computer and a magnetic tape cassette recorder.

**cassette recorder** Device designed to use cassettes to record and store digital data and, at a later time, reload this data into the computer's internal storage. Used widely with microcomputers.

**cassette tape** Magnetic tape, approximately  $\frac{1}{8}$  inch wide, that is housed in a small plastic container. Cassette tape is read by a *cassette recorder*.

**CAT** Acronym for Computer-Assisted Training and *Computerized Axial Tomography*

**catalog** Ordered compilation of item descriptions and sufficient information to afford access to the items, such as a listing of programs or data file names that are stored on a diskette. To catalog a disk is to instruct the computer to print out a list of all of the files on the disk.

**catena** Connected series. See *concatenate*

**cathode ray tube (CRT)** Electronic tube with a screen upon which information may be displayed. See *display*, *screen*, and *video display terminal*.

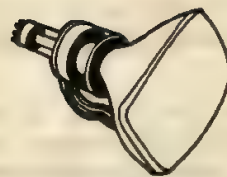


## GAME PROGRAMS

1. BLACKJACK
2. CRAPS
3. ROULETTE
4. POKER
5. SLOT MACHINE
6. KENO

Catalog

**CBASIC** Popular language for 8080, 8085, and Z80 microprocessor computers. Much faster in execution than the more popular interpreter BASIC. This high-level language is not *interactive*; a CBASIC program is translated into object code before it is executed.



Cathode ray tube

**CBBS** Acronym for Computerized Bulletin Board Service. See *electronic bulletin board*.

**CBEMA** Acronym for Computer and Business Equipment Manufacturers Association.

**CBI** Acronym for *Charles Babbage Institute*.

**CBL** Acronym for *Computer-Based Learning*.

**C<sup>3</sup>L** Acronym for Complementary Constant Current Logic.

**CCD** Acronym for *Charge-Coupled Device*.

**CCITT** Acronym for Consultative Committee International Telegraph and Telephone, an or-

```

      REM Accept an input from the operator
10  INPUT "Enter a number between 1 and 5:" INZ
      IF NZ<1 THEN GOTO 10
      IF NZ>5 THEN GOTO 10\
      ELSE ON NZ GOTO\

```

```

100,\ Print "one"
200,\ Print "two"
300,\ Print "three"
400,\ Print "four"
500 REM Print "five"

```

```

100  PRINT "one"      :STOP    REM 1 input
200  PRINT "two"      :STOP    REM 2 input
300  PRINT "three"    :STOP    REM 3 input
400  PRINT "four"     :STOP    REM 4 input
500  PRINT "five"     :STOP    REM 5 input
      END

```

CBASIC

ganization established by the United Nations to develop worldwide standards for data communications.

**CCP** Acronym for Certificate in Computer Programming. CCP examinations are given annually at test centers in colleges and universities in the United States, Canada, and several international locations. Three separate full-day examinations test a common core of programming knowledge and an area of specialization: business programming, scientific programming, or systems programming. The common core of knowledge emphasizes such areas as data and file organization, techniques of programming, programming languages, interaction with hardware and software, and interaction with people.

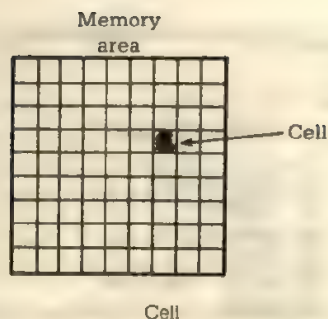
**CDC** Acronym for Call Directing Code, a two- or three-character code used to route a message or command automatically.

**CDP** Acronym for Certificate in Data Processing. CDP examinations are given annually at test centers in colleges and universities in the United States, Canada, and several international locations. This broad-based examination consists of five sections and requires half a day to complete. In addition to having experience requirements and espousing the Code of Ethics, CDP candidates must successfully complete all five sections of the examination to receive the certificate. Originated by the DPMA, testing is now administered, and certificates issued, by the *Institute for Certification of Computer Professionals*.

**CE** Acronym for *customer engineer*.

**cell** (1) Storage for one unit of information, usually one character, one byte, or one word. A binary cell is a cell of one binary digit capacity. (2) Single coordinate location within the grid, or matrix, that constitutes the basic form of an electronic spreadsheet.

**center** Keyboard function that places the information being typed in the center of the line.



**centi** Metric prefix meaning hundredth. Contrast with *hecto*, one hundred.

**centisecond** One hundredth of a second.

**central information file** Main data storage system.

**centralized data processing** Concept by which a company has all its computing equipment located at the same site, and field-office operations have no effective data processing capability. Contrast with *distributed data processing*.

**centralized design** Information structure in which a separate data processing department provides data processing facilities for the organization.

**centralized network configuration**

Structure of a computer network whose dominating feature is a central computer that, one way or another, is involved in everything that happens in the system. Also called *star network*.

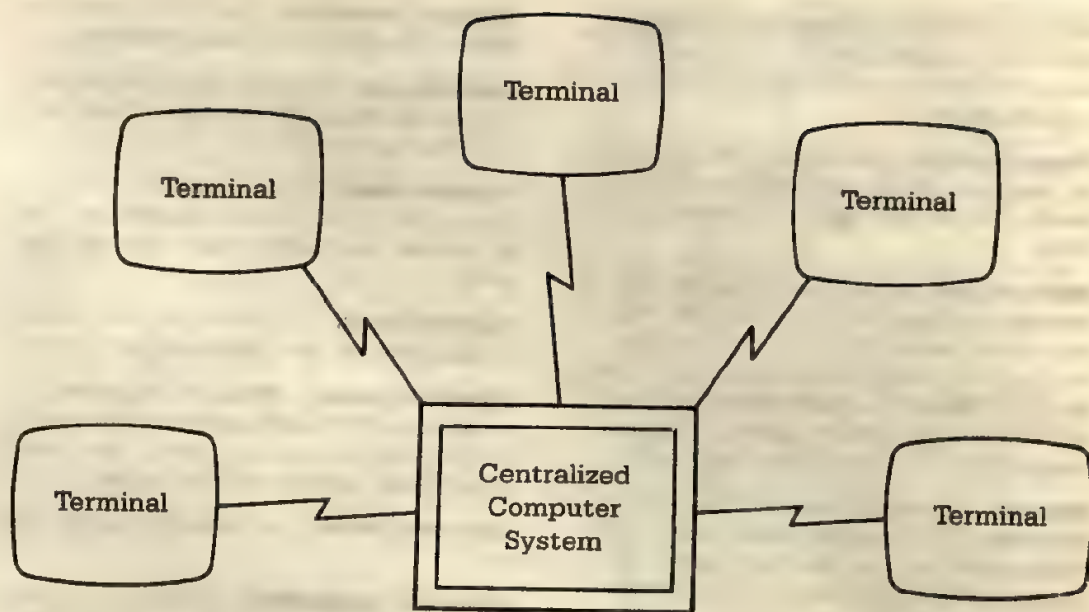
**central processing unit (CPU)** Major component of a computer system with the circuitry to control the interpretation and execution of instructions. Includes the *arithmetic-logic unit* and *control unit*.

**central processor** See *central processing unit*.

**central site** Main installation of a *distributed information processing system*.

**Centronics interface** Popular *parallel inter-*





Centralized network configuration

face used generally to connect printers to computers. Centronics was one of the original printer manufacturers to use the parallel scheme for communications between computers and printers.

#### **Certificate in Computer Programming**

See *CCP*.

#### **Certificate in Data Processing** See *CDP*.

**certification** (1) Acceptance of software by an authorized agent, usually after the software has been validated by the agent, or after its validity has been demonstrated to the agent. (2) Voluntary system of attesting that a person has achieved a certain professional status, usually by passing a rigorous examination. See *CCP* and *CDP*

**chain** (1) Linking of records by means of *pointers* in such a way that all like records are connected, the last record pointing to the first. (2) Set of operations that are to be performed sequentially.

**chained files** Data files where data blocks are chained together by using *pointers*.

**chained list** List in which each item points to the next item and the order of retrieval need not have any relation to the storage order.

**chain field** Field in a record that defines the location and storage device of other data items logically related to the original record but not physically attached.

**chaining** (1) Process of linking a series of records, programs, or operations together. (2)

## chaining search

Method of allowing the execution of programs larger than the main memory of a computer by loading and executing modules of the same program sequentially.

**chaining search** Technique used for retrieving data from a file by using addresses in the records that link each record to the next in the chain.

**chain printer** Impact *line printer* that has its character set assembled on a chain revolving horizontally past all print positions; it prints when a print hammer (one for each column on the paper) presses the paper against an inked ribbon that in turn presses against the appropriate characters on the aligned print chain.

**channel** (1) Path for electrical or electronic transmission between two or more points. Also called a *path*, *link*, *line*, *facility*, or *circuit*. (2) Transmission path that connects auxiliary devices to a computer.

**channel adapter** Device that enables data communications between channels on different hardware devices.

**channel capacity** In data communications, an expression of the maximum number of bits per second that can be accommodated by a channel. This maximum number is determined by the bandwidth modulation scheme and certain types of noise. The channel capacity is most often measured in bauds, or bits per second.

**character** Any symbol, digit, letter, or punctuation mark—including the *blank character*—stored or processed by computing equipment

**character checking** Checking of each character by examining all characters as a group or field.

**character code** Code designating a unique numerical representation for a set of characters.

**character density** See *density*.

**character generator** Circuit that forms the letters or numbers on a screen or printer.

**characteristic** That part of a floating-point number that represents the size of the *exponent*. See *mantissa*.

**character map** Grid of blocks on a display screen, where each block corresponds to a letter, number, punctuation mark, or special character.

**character pitch** In a line of text, the number of characters per inch. See *elite type* and *pica*.

**character printer** Printer in which only a single character is composed and determined within the device prior to printing. Also called *serial printer*. Contrast with *line printer*.

**character reader** See *optical character reader*.

**character recognition** Technology of using machines to identify human-readable symbols automatically, and then to express their identities in machine-readable codes. This operation of transforming numbers and letters into a form directly suitable for electronic data processing is an important method of introducing information into computing systems. See *magnetic ink character recognition* and *optical character recognition*.

**character set** All of the numbers, letters, and symbols associated with a given device or coding system. All of the characters recognized by a computer system.

**characters per inch** Method of expressing the output from dot matrix and daisy wheel printers as determined by type size and style. Abbreviated *cpi*.

**characters per second** Unit for measuring output of low-speed serial printers. Abbreviated *cps*.

**character string** String of alphanumeric characters.

**character template** Device used to shape



an electron beam into an alphanumeric character for a CRT display.

**charactron** Special type of cathode ray tube that displays alphanumeric and special characters on its screen.

**charge** Quantity of unbalanced electricity in a body.

**charge coupled device (CCD)**

Semiconductor memory device within which stored information circulates rather than remains in fixed locations.

**Charles Babbage Institute** Organization for the study of the *information revolution* from a historical perspective. Intended as a clearing-house for information about research resources related to this history and a repository for archival materials.

**chart** (1) Visual representation of quantitative information—such as a bar graph, in which the information is made visual by heavy horizontal or vertical lines, or a circle graph or pie chart, in which the information is pictured as slices of an imaginary pie. (2) See *flowchart* and *structure chart*.

**chassis** Metal frame upon which the wiring sockets, and other parts of an electronic assembly are mounted.

**check bit** Binary check digit, such as a *parity bit*.

**check digits** One or more digits carried within a unit item of numerical data to provide information about the other digits in the unit in such a manner that, if a transcription or transposition error occurs in subsequent data entry, the check fails, and an indication of error is given.

**checkout** See *debug*.

**checkpoint** Specified point at which a program can be interrupted, either manually or by a control routine. Used primarily as an aid in debugging programs.

**check problem** Testing problem designed to determine whether a computer or a computer program is operating correctly. See *bug*, *debug*, and *test data*.

**check sum** Summation of digits or bits used primarily for checking purposes and summed according to an arbitrary set of rules. Used to verify the integrity of data.

**chief programmer** Individual designated as the leader of a programming team. Has the overall responsibility of seeing that an entire project is successfully completed.

**chief programmer team** Organization for computer programming wherein a very superior programmer is the technical leader of a team consisting, as a minimum, of a chief programmer himself, a backup programmer, and a *programming librarian/programming secretary*. As needed, the team may be augmented with two to three additional members and may consult specialists. The key concepts are those of: (1) Making programming a public "engineering" practice instead of a private art. (2) Providing support so that a very superior creator can concentrate on creating.

**child** Data record that can be created only based upon the contents of one or more other records (parents) already in existence. See *parent* and *parent/child relationship*.

**chip** Small component that contains a large amount of electronic circuitry. Thin silicon *wafer* on which electronic components are deposited in the form of *integrated circuits*. Chips are the building blocks of a computer and perform various functions, such as doing arithmetic, serving as the computer's memory, or controlling other chips. (See page 44.)

**chip family** Group of related chips, each of which (except the first) evolved from an earlier chip in the family.

**chop** To discard unneeded data.

**chroma** Color attributes, such as saturation, shade, and hue.



Chip

**chromaticity** Dominant wavelength and purity of a color as objectively measured; corresponds to hue and saturation of the color without regard to brightness.

**chrominance** Portions of composite video signal controlling color.

**chunking along** Slang term referring to the operation of a long running, dependable program.

**churning** See *thrashing*.

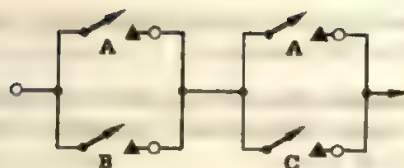
**CICS** Acronym for Customer Information Control System, widely used teleprocessing monitor.

**CIM** Acronym for *Computer Input Microfilm*.

**cipher** Secret method of representing information to ensure computer security.

**CIPS** Acronym for *Canadian Information Processing Society*.

**circuit** (1) Pathway designed for the controlled flow of electrons. (2) System of conductors and related electrical elements through which electrical currents flow. (3) Communication link between two or more points.



Circuit

**circuit board** Thin insulating board used to mount and connect various electronic components and microchips in a pattern of conductive lines. This circuit pattern is etched into the board's surface. Also called *printed circuit board*.

**circuit capacity** Number of channels in a circuit that can be dealt with simultaneously.

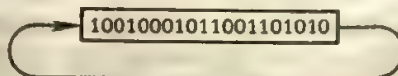
**circuit card** See *circuit board*.

**circuitry** Complex of circuits describing interconnection within or between systems.

**circuit switching** Physical connection between two nodes in a communication network that dedicates bandwidth of that circuit until the connection is dropped.

**circular list** Linked list, usually of data elements, in which the last element points to the first one. Also called a *ring*.

**circular shift** Shifting operation whereby bits or characters shifted off one end of a register enter the register on the opposite end. Also called *end-around shift*.



Circular shift

**CIU** Acronym for *computer interface unit*.

**cladding** In fiber optics, the second layer of the fiber optics unit that bounces the light waves back into the core of the unit.

**classify** To categorize or place data with similar characteristics into the same category.

**clear** (1) Keyboard function that removes the



contents from the display screen. (2) Same as *zap*.

**clearing** Replacing the information in a register, storage location, or storage unit with zeros or blanks.

**click** Process of pressing the *mouse* button.

**click art** Disk of drawings and pictures that are ready to clip out and use in computer-produced documents.

**CLIP** Acronym for Coded Language Information Processing, a scheme used by radiologists for entering their X-ray reports into a computer.

**clipboard** Portion of a computer's memory set aside to store data being transferred from one file or application to another.

**clipping** Removing portions of an image that are outside the boundaries of the display screen. Also called *scissoring*.

**clobber** To write new data over the top of good data in a file or otherwise damage a file so that it becomes useless. To wipe out a file.

**clock** (1) Timing device that generates the basic periodic signal used to control the timing of all operations in a synchronous computer. (2) Device that records the progress of real time, or some approximation of it, and whose contents are available to a computer program.

**clocking** Technique used to synchronize a sending and a receiving data communications device. Permits synchronous transmission at high speeds.

**clock pulse** Synchronization signal provided by a clock.

**clock rate** Time rate at which pulses are emitted from a clock.

**clock track** Track on which a pattern of signals has been recorded to provide a time reference.

**clone** In nonbiological terms, a product or

idea that is an exact duplicate or copy of another

**closed file** File that cannot be accessed for reading or writing. Contrast with *open file*.

**closed loop** Loop that is completely circular.

**closed routine** See *closed subroutine*.

**closed shop** Operation of the data processing center by professional operators. Programs and data are carried by messengers or transmitted over telephone lines, avoiding the necessity of users entering the computer room and enabling a much more efficient use of the computer. Contrast with *open shop*.

**closed subroutine** Subroutine stored at one place and linked to one or more calling routines. Contrast with *open subroutine*.

**cluster controller** Down-line processor that collects data from a number of low-speed devices then transmits concentrated data over a single communications channel. See *concentrator*.

**clustered devices** Group of terminals connected to a common controller.

**clustering** Grouping things with similar characteristics.

**CMI** Acronym for *Computer-Managed Instruction*.

**CML** Acronym for *Current Mode Logic*. See *ECL*.

**CMOS** Acronym for *Complementary MOS*.

**CMU** Acronym for Carnegie-Mellon University, an important computer and robotics research center.

**coaxial cable** Special type of communications cable that permits transmission of data at high speed. Usually employed in local networks. (See page 46.)

**COBOL** Acronym for COmmon Business-Oriented Language, a high-level language de-



Coaxial cable

veloped for business data processing applications. Every COBOL source program has four divisions: (1) Identification Division identifies the source program and output of a compilation; (2) Environment Division specifies those aspects of a data processing problem that are dependent upon the physical characteristics of a particular computer; (3) Data Division describes the data that the object program is to accept as input, manipulate, create, or produce as output; and (4) Procedure Division specifies the procedures to be performed by the object program, using English-like statements

**CODASYL** Acronym (pronounced code-a-sill) for Conference on Data Systems and Languages, a federally sponsored industry committee that developed standards that led to the

COBOL language and many of the more complex types of databases.

**code** (1) Set of rules outlining the way in which data may be represented. (2) Rules used to convert data from one representation to another. (3) To write a program or routine. Same as *encode*.

**code conversion** Process for changing the bit groupings for characters in one code into the corresponding character bit groupings for a second code.

**coded decimal number** Number consisting of successive characters or a group of characters that usually represents a specific figure in an associated decimal number. See *binary coded decimal number*.

**code level** Number of bits used to represent a given character.

**coder** One who expresses a problem design, or part of a problem, in a computer language. "Coder" is often used in the derogatory sense of a person who does little analysis and planning, but merely expresses someone else's design in a computer language.

```

100  PROCEDURE DIVISION
110  PGM-VWGIN.MOVE ZEROS TO TOTAL-COUNT, INC.
120  LOOP. IF INC IS GREATER THAN 100
130      GO TO PGM-END.
140      ADD 1 TO INC.
150      ADD INC TO TOTAL-COUNT.
160      GO TO LOOP.
170  PGM-END. STOP RUN.
    
```



FORTRAN CODING FORM																																							
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### Coding form

**code set** Complete set of representations defined by a code. All of the two-letter post office identifications for the 50 states constitute a code set.

**coding** (1) Writing a list of instructions that will cause a computer to perform specified operations. (2) Ordered list or lists of the successive instructions that will cause a computer to perform a particular process.

**coding form** Form on which the instructions for programming a computer are written. Each programming language has its own coding form. Also called *coding sheet*.

**coding sheet** See *coding form*.

**coercion** In programming language expressions, an automatic conversion from one data type to another.

**COGO** Acronym for COordinate GeOMetry, a problem-oriented programming language used

to solve geometric problems. Used primarily by civil engineers.

**coherence** Assumption used in raster scan display technology that attributes the same value of an individual pixel to its adjacent pixel.

**cold boot** Act of turning a computer on and loading an operating system into it. Contrast with *warm boot*.

**cold fault** Computer fault that is apparent as soon as the machine is switched on.

**cold start** Restart activity used when a serious failure has occurred in a system, making the contents of the direct access storage inaccessible so that no trace of the recent processing can be used. The system must be reloaded and activity restarted as though at the beginning of a day. More simply, restarting the computer by turning it off and then on again—all programs and data in memory are lost.

**collate** To merge two or more sequenced data sets to produce a resulting data set that reflects the sequencing of the original sets.

**collating sort** Sort that uses a technique of continuous merging of data until one sequence is developed.

**collation sequence** Order that the computer will use when it arranges items from first to last. Typically, this order is alphabetical for words and numerical for numbers. However, the question becomes complex when one must take into account upper-case and lower-case, mixed numbers and words, punctuation, numbers that are not filled to the same length with leading zeros, and other factors.

**collator** Machine used to collate or merge sets of cards or other documents into a sequence.

**collection** Process of gathering data from various sources and assembling it at one location.

**collector** Section of a semiconductor device towards which electricity flows. See *base*, *emitter*, and *transistor*.

**collision** Result of keys colliding at the same address when two keyboard operations are ordered simultaneously. Programming in the computer's *operating system* defines which operation will be performed.

**collision detection** (1) In computer graphics, particularly in arcade-type games, a program often must determine when two objects have collided. Several programming techniques may be used to detect a collision. (2) Task performed in a multiple-access network to prevent two computers from transmitting at the same time

**color burst signal** Signal present in *composite video* output that provides color information. Sometimes turning off the color burst signal improves the quality of pictures on black-and-white monitors.

**color camera** Output device used to record data from raster scan display devices.

**color coding** Process of identifying records by using different colors for different types of records.

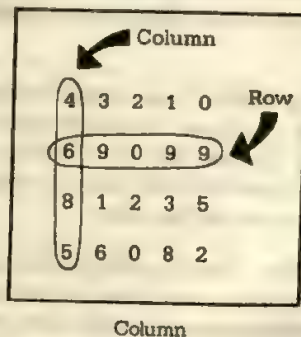
**color graphics** Any system used to create graphs, draw pictures, and so forth, using colors.

**color map** In computer graphics, a scheme whereby a limited number of bits can be made to do the work of more

**color printer** Output device that can produce text, charts, graphics, and artwork in several colors.

**COLOSSUS** Special-purpose computer developed in 1943 to crack German codes.

**column** (1) Vertical members of one line of an *array*. (2) One of the vertical lines of punching positions on a punched card. (3) Position of information in a computer word. (4) Horizontal division of an electronic spreadsheet. Together with rows, columns serve to form the spreadsheet matrix. Contrast with *row*.



**column split** Device for distinguishing the pulses corresponding to an 11 or 12 punch from those corresponding to numeric punches in a card column and for making them separately available while reading or punching a card.

**COM** Acronym for *Computer Output Microfilm*.



**combination logic** Circuit arrangement in which the output state is determined by the present state of the input. Digital system not utilizing memory elements. Contrast with *sequential logic*.

**combinatorial explosion** Condition that occurs in problem solving when the possibilities to be examined become too numerous for the computer. Can occur even with very large computers.

**combinatorics** Study of methods of counting how many objects there are of some type, or how many ways there are to do something—combinations and permutations.

**COMDEX** Acronym for COMMUNICATIONS and Data processing EXposition, a large computer trade show held in the United States and other locations.

**comic book** The first computerized "comic book" was produced in 1985. First Comics, producer of the book *Shatter*, used a Macintosh microcomputer as the development tool for the new comic. See *electronic publishing*.

**COMIT** One of the *string processing languages*.

**command** (1) Control signal. (2) Loosely, a mathematical or logic operator. (3) Loosely, a computer instruction. See *operation code*.

**command-chained memory** Technique used in dynamic *storage allocation*.

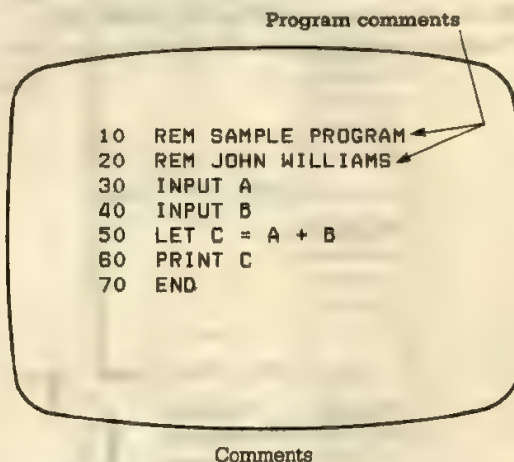
**command-driven software** Programs that make little or no effort to guide the terminal user with menus. Instead, command-driven software expects the operator to know what commands are available and when each is appropriate.

**command key** Any keyboard key used to perform specific functions

**command language** Language used to give instructions to an operating system. See *job control language*.

**command processing** Reading, analyzing, and performing of computer instructions.

**comments** English prose that may be interspersed among the computer-language statements of a computer program to explain their action to human readers of the program. Special markers on the comments cause the computer to ignore them. Properly done comments are a valuable form of *internal documentation* because they are embedded in the program itself; therefore they stay with the program. Comments provide helpful notes for future users who may later attempt to understand or alter the program. See *remarks*.



**Commodore International, Inc.** Company that specializes in producing microcomputer systems for home use. Commodore's PET, VIC, and Commodore 64 have been extremely popular and are in wide use. The company now produces larger microcomputer systems, including the Commodore 128 and Amiga.

**common carrier** Government-regulated private company that provides telephone, telegraph, and other telecommunications facilities for public use.

**common language** Computer programming language sensible to two or more computers with different machine languages. BASIC,

## common storage

COBOL, FORTRAN, and Pascal are common languages. Also called *universal language*.

**common storage** Section of memory for each user that holds data or parameters that are accessible to all programs.

**communicating** Process of transmitting information to a point of use.

**communicating word processors** Network of word processors used to transmit *electronic mail*.

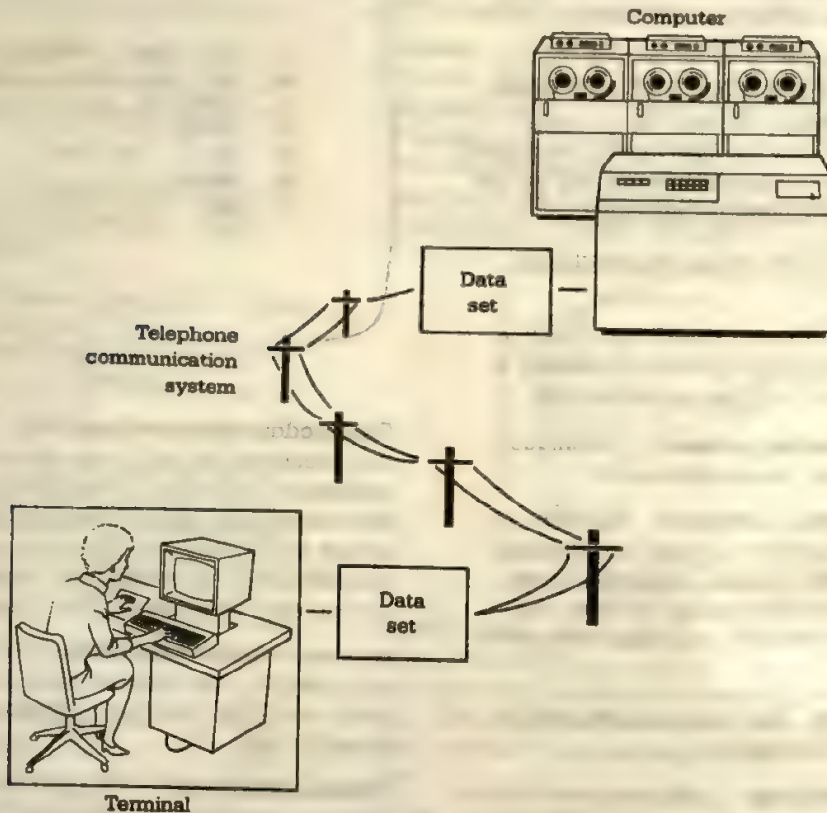
**communication** (1) Flow of information from one point (the source) to another (the receiver). (2) Act of transmitting or making known. (3) Process by which information is exchanged be-

tween individuals through the use of a commonly accepted set of symbols. See *data communications*.

**communications channel** Physical means of connecting one location or device to another for the purpose of transmitting and receiving data. Coaxial cables, fiber optics, microwave signals, telephone lines, and satellite communications all serve as communications channels.

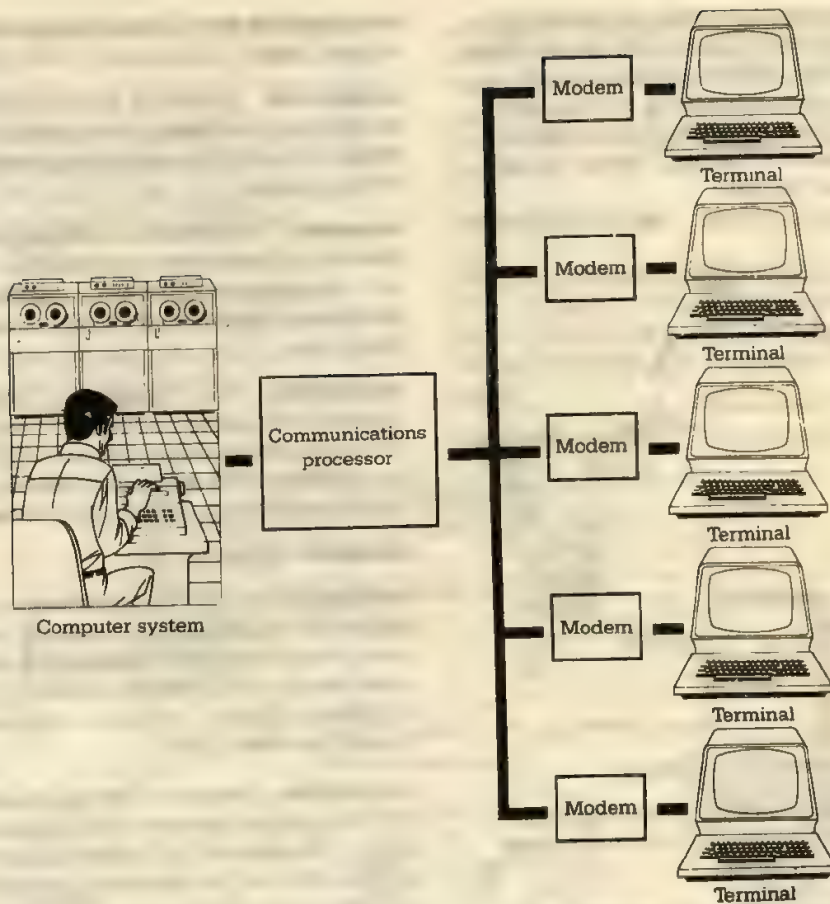
**communications control unit** Usually, a small computer whose only job is to handle the flow of data communications traffic to and from a mainframe computer.

**communications link** Method by which information is transmitted between computer devices. See *link*.



Communications





Communications processor

**communications processor** Computer that provides a path for data transfer between the computer system and the data communications network.

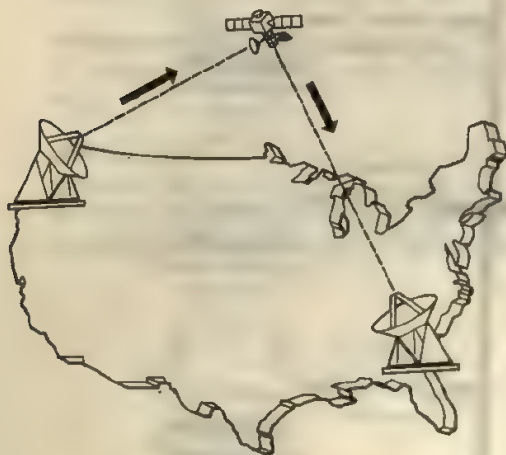
**communications protocol** Set of communication rules that provides for error checking between devices and ensures that transmitted data are not lost.

**Communications Satellite Corporation (COMSAT)** Privately owned U. S. communications carrier company operating under a mandate from Congress. American representa-

tive in the INTELSAT organization, it provides technical and operational services for the global communications system. Traffic on the system is coordinated through an operations center in Washington, D.C.

**communications satellites** Earth satellites placed in different spots in the geostationary orbit 36 000 km (22 250 mi) above the equator that serve as relay stations for communications signals transmitted from Earth stations. These satellites orbit Earth once every 24 hours, giving the impression that they are "parked" in one spot over the equator. Once in this orbit, a

satellite is capable of reaching 43 percent of Earth's surface with a single radio signal. Most communications satellites are launched by NASA, weigh several thousand pounds, and are powered by solar panels. A few communications satellites are Comstar, Westar, Intelsat V, Satcom, and Marisat.



Communications satellite

**communications server** Device that connects local area networks to wide area or telecommunications networks.

**communications software** Programs that allow computers to communicate through a *modem*. Some communications programs are capable of automatic telecommunications, such as auto-answering, auto-dialing, and even dialing another computer at a preset time to establish communication and send and receive information. Some programs allow operation of an unattended remote computer—accessing disk files, operating peripherals, and so forth.

**communications system** System that consists of senders, physical channels, and receivers of data communications.

**compaction** Packing of data structures to make room in storage.

**comparative sort** Sort by comparison of two or more keys.

**comparator** Device for checking the accuracy of transcribed data by comparing it with a second transcription, noting any variation between the two

**compare** To examine the representation of a quantity to determine its relationship to zero, or to examine two quantities, usually for the purposes of determining identity or relative magnitude.

**comparison** Act of comparing. Common forms are comparison of two numbers for identity or for relative magnitude, two characters for similarity or for alphabetic ordering, and comparison of the signs of two numbers.

**compart** Computer art.

**compatibility** (1) Property of some computers that allows programs written for one computer to run on another (compatible) computer, even though it is a different model. (2) Ability of different devices, such as a computer and a printer, to work together.

**compatible** Pertains to the degree of interworking possible between two devices or systems. If an element in a system is fully compatible with the functional and physical characteristics of a system, it can be incorporated into the system without modification.

**compatible software** Programs that can be run on different computers without modification.

**compilation** One of two principal means of translating programs written in high-level languages into machine-language instructions that can be directly executed by the processor. Entails translating a complete program before any execution. Contrast with *interpretation*, in which each instruction is translated when it is to be executed.

**compilation time** Time during which a source-language program is translated (com-



piled) into an object program (machine language). Also called *compile time*. Contrast with *run time*.

**compile** To prepare a machine-language program (or a program expressed in symbolic coding) from a program written in high-level programming language such as FORTRAN, COBOL, or Pascal.

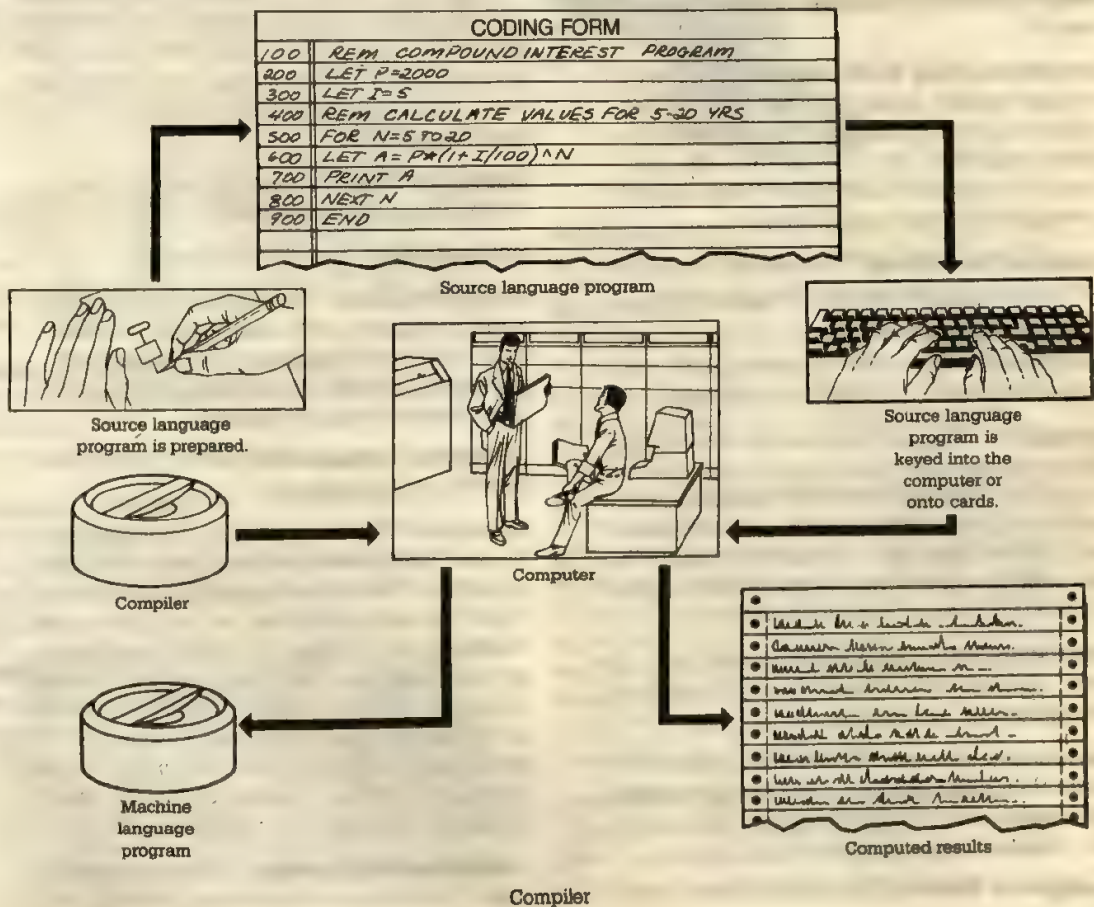
**compile-and-go** Operating technique by which the loading and execution phases of a program compilation are performed in one continuous run. Especially useful when a program must be compiled for a one-time application. See *load-and-go*.

**compiler** Computer program whose purpose is that of translating high-level-language statements into a form that can directly activate the computer hardware. Translates a complete program before any execution. Contrast with *interpreter*.

**compiler-compiler** Same as *metacompiler*.

**compiler language** Source language that uses a compiler to translate the language statements into an object language. See *problem-oriented language* and *procedure-oriented language*.

**compiler program** See *compiler*.



compile time

**compile time** Time required to compile a program. The point in the processing of a program when it is being translated from source code to object code by a translator (compiler). Also called compilation time.

**compiling** See *compile* and *cross-compiling/assembling*.

**complement** Number used to represent the negative of a given number. Obtained by subtracting each digit of the number from the number representing its base and, in the case of *two's complement* and *ten's complement*, adding unity to the last significant digit. Also called radix complement.

**complementary constant current logic**  
See *C<sup>2</sup>L*

**complementary MOS (CMOS)** Method of making metallic oxide semiconductor (MOS) chips that uses almost no power and works faster than MOS. Not very good for LSI, but used in electronic watches and clocks where power has to come from a battery.

**completeness check** Establishes that none of the fields is missing and that the entire record has been checked.

**component** Basic part; *element*; part of a computer system; portion of an application.

**composite** Type of video signal in which all three primary video color signals (red, green, blue) are combined, which limits the sharpness of the monitor image. Used in some monitors and TV sets that use only one electron gun to generate the three primary colors. See *composite video*. Contrast with *RGB video*

**composite card** Multipurpose data card, or a card that contains data needed in the processing of various applications.

**composite symbol** Symbol consisting of more than one character, such as the composite symbol  $< >$ , which stands for "not equal to" in some software systems.

**composite video** Color output from a com-

puter color display described in terms of its hue and its brightness and encoded in a single video signal. The color control signal is a single data stream that must be decoded into three colors (red, green, and blue). Inexpensive color monitors, called composite monitors, use composite video and produce a slightly better picture than a TV set but not the high quality of *RGB monitors*.

**compound statement** Single instruction that contains two or more instructions that could otherwise be used separately.

**CompuServe** Major information service network used by individuals as well as businesses. Carries timely news features, stock market reports, electronic mail, educational programs, programming aids, and more. Personal computer owners can reference the CompuServe network via the common telephone system. Compare *Source (The)*

**computability** Property by which computational problems are classified.

**computation** Result of computing.

**compute-bound** Pertaining to a program or computer system that is restricted or limited by the speed of the central processing unit. Same as *processor bound*. See *limiting operation*. Contrast with *I/O bound*.

**computed tomographic (CT)** See *computerized axial tomography*.

**computer** Device capable of solving problems or manipulating data by accepting data, performing prescribed operations (mathematical or logical) on the data, and supplying the results of these operations. See *analog computer*, *briefcase computer*, *computer kit*, *desktop computer*, *digital computer*, *hand-held computer*, *home computer*, *lap computer*, *mainframe*, *microcomputer*, *microprocessor*, *minicomputer*, *personal computer*, *portable computer*, *small business computer*, and *supercomputer*.

**computer-aided design** Process involving direct, real-time communication between a de-



signer and a computer, generally by the use of a CRT display and a light pen or *tablet*.

**computer-aided design/computer-aided manufacturing (CAD/CAM)** Efforts to automate design and manufacturing operations, a rapidly-growing branch of computer graphics, currently relying primarily on *calligraphic graphics* but branching out to incorporate *raster graphics*. Wide-ranging uses include designing auto parts, buildings, and integrated circuits.

**computer-aided factory management** System for managing a production facility in which computers schedule operations, keep accurate accounts on parts inventories, and order new supplies as required from supply houses.

**computer-aided manufacturing (CAM)** Use of computer technology in the management, control, and operation of manufacturing.

**computer-aided materials delivery** Use of computer-directed conveyor belts and robot carts to move materials and parts through a factory to maximize throughput and other measures of productivity.

**computer-aided materials selection** Use of computers to help determine what materials should be used in the construction of a new part or component.

**computer architecture** Area of computer study that deals with the physical structure (hardware) of computer systems and the relationships among these various hardware components.

**computer art** Art form produced by artists using computer equipment. For the artist, the computer can be considered a tool, as a paintbrush, a charcoal pencil, or an extension of the mind. The artist can dream lovely images and use the computer to bring them to vivid reality. Computer art is usually produced on visual displays, graphics printers, digital plotters, or film copying devices.



Computer art

**computer artist** Person who uses computers as tools in producing art. See *computer art*.

**computer-assisted diagnosis** Using a computer as a diagnostic tool to save doctors time and assist in a speedy, accurate diagnosis. The computer is used to evaluate medical data to show variations from normal and suggest a diagnosis.

**computer-assisted instruction (CAI)** Use of computers to augment individual instruction by providing students with programmed sequences of instruction under computer control. Manner of sequencing the materials permits students to progress at their own rate. Responsive to students' individual needs. See *author language*, *authors*, *courseware*, *PILOT*, *PLAN-IT*, *PLATO*, and *TICCIT*. Not synonymous with *computer-augmented learning*.

**computer-augmented learning (CAL)** Method of using a computer system to augment, or supplement, a more conventional instructional system, such as by using simulation

## computer awareness

programs to aid in problem solving in a course of instruction. Not synonymous with *computer-assisted instruction*.

**computer awareness** Generally, an understanding of what a computer is, how it works, and the role and impact of computers in society.

**computer-based learning (CBL)** Term used to embrace all the present forms of educational computing.

**computer binder** Binder designed to hold and protect printouts produced by printers.

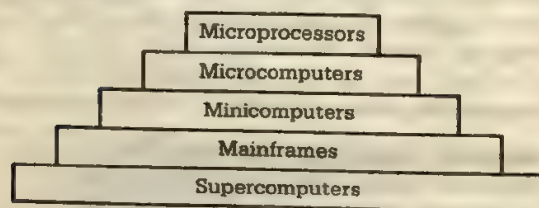
**computer camp** Camp, usually held during the summer weeks, where campers not only swim and eat, but also learn to use microcomputers.

**computer center** Facility that provides computer services to a variety of users through the operation of computer and auxiliary hardware, and through ancillary services provided by its staff.

**computer center director** Individual who directs the activities, operations, and personnel in a computer center.

**computer circuits** Circuits used in digital computers, such as gating circuits, storage circuits, triggering circuits, inverting circuits, and power amplifying circuits.

**computer classifications** Computers fall into two major classifications: digital and analog. A third classification, called hybrid, combines both digital and analog computers. Digital computers vary in size from huge supercomputers to minute microprocessors.



Computer classifications

**computer code** Machine code for a specific computer.

**computer conferencing** Telecommunication between several participants in a *network*. Exchanging information and messages between multiple parties via telecommunication provides an alternative to telephone conferencing and actual meetings between people. See *teleconference*.

**computer control console** See *control panel*.

**computer crime** Intentional act to misuse a computer system. Computer crimes can range from simple fraud schemes to crimes of violence. Use of computers to commit unauthorized acts. Legally, not yet well defined.

**computer enclosure** Cabinet or housing for a computer's circuit boards and power supply.

**computer engineering** Field of knowledge that includes the design of computer hardware systems. Offered as a degree program in several colleges and universities. Contrast with *software engineering*.

**computerese** Jargon and other specialized vocabulary of people working with computers and information processing systems.

**computer family** See *family of computers*.

**computer flicks** Movies made by a computer.

**computer game** Interactive software or firmware in which the input data consists of the human player's physical actions and the output is an interactive graphics display. See *arcade game* and *computerized game playing*.

**computer graphicist** Specialist who uses computer graphics systems to produce graphs, charts, animated diagrams, art forms, and graphics designs.

**computer graphics** General term meaning the appearance of pictures or diagrams, as distinct from letters and numbers, on the display screen or hard-copy output device.



**computer-independent language** High-level language designed for use in any computer equipped with an appropriate compiler, such as BASIC, COBOL, FORTRAN, Pascal, and PL/I. See *problem-oriented language*, *procedure-oriented language*, and *common language*.

**computer industry** Industry composed of businesses and organizations that supply computer hardware, software, and computer-related services.

**computer information system (CIS)** Coordinated collection of hardware, software, data, people, and support resources to perform an integrated series of functions that can include processing, storage, input, and output.

**computer input microfilm (CIM)** Technology that involves using an input device to read the contents of microfilm or microfiche directly into the computer. Contrast with *computer output microfilm*.

**computer instruction** See *instruction*.

**computer integrated manufacturing (CIM)** Concept of a totally automated factory in which all manufacturing processes are integrated and controlled by a CAD/CAM system. CIM enables production planners and schedulers, shop/floor foremen, and accountants to use the same database as do product designers and engineers.

**computer interface unit (CIU)** Device used to connect peripheral devices to a computer.

**computerization** (1) Application of a computer to an activity formerly done by other means. (2) Actual reshaping of society by the widespread adoption and use of computers.

**computerized axial tomography (CAT)** Computer controlled X-ray technique that shows a picture of a site through the body at a given depth. The computer is used to bring out the details of this picture, recording X rays passing through the body in changing directions and generating an image of the body's structure.

**computerized database** Set of computerized files on which an organization's activities are based and upon which high reliance is placed for availability and accuracy.

**computerized game playing** Recreational use of computers (microcomputers, minicomputers, and mainframes) that have been programmed to play a wide variety of games, such as tic-tac-toe, Pacman, Breakout, Star raiders, Space war, blackjack, hangman, backgammon, chess, and checkers, among others. See *arcade game* and *computer game*.

**computerized mail** Technique of delivering mail in electronic form directly to homes and businesses through computer equipment. See *electronic mail*.

**computerized numerical control** See *numerical control*.

**computer jargon** Technical vocabulary associated with the computer field. See *computerese*.

**computer kit** Microcomputer in kit form. The user who purchases a computer kit is expected to "build" the microcomputer as he/she would "build" a model airplane or a stereo sound system. Microcomputer kits are popular with computer hobbyists and are used in schools to help teach computer design. See *personal computer*.

**computer language** See *programming language*.

**computer leasing company** Company that specializes in leasing computer equipment that it purchases from a computer manufacturer.

**computer letter** Personalized form letter produced by a word processing system or a special form-letter program.

**computer literacy** Broad knowledge of how to use computers to solve problems, general awareness of the functioning of the software and hardware, and an understanding of the societal implications of computers. Nontechnical study of the computer and its effect upon

## computer-managed instruction (CMI)

society that provides one with some of the knowledge, tools, and understanding to live in a computer-oriented society. State of being able to function comfortably as a user in a computerized environment but not necessarily possessing technical comprehension.

## computer-managed instruction (CMI)

Application of computers to instruction in which the computer is used as a record keeper, manager, and/or prescriber of instruction.

**Computer Museum** Archive for computer history, located in Boston, Massachusetts, whose collection contains many early computer systems and taped presentations of computer pioneers.

**computer music** Music employing computer equipment at any stage of its composition or realization as sound. See *electronic music* and *musical language*.

**computer network** Complex consisting of two or more interconnected computer systems, terminals, and communication facilities.

**computernik** Avid computer user who chooses to spend a large amount of time using computers.

**computer numerical control** Technique by which a machine-tool control uses a computer to store numerical control instructions generated earlier by CAD/CAM for controlling the machine.

**computer-on-a-chip** Complete microcomputer on an integrated circuit chip. See *microprocessor* and *microcomputer chip*.

**computer operations** That part of a computer installation responsible for the day-to-day collection, production, distribution, and maintenance of data.

**computer operations manager** Person who oversees the computer operations area in an organization. Responsible for hiring personnel and scheduling work that the system is to perform.

**computer operator** Person skilled in the operation of the computer and associated peripheral devices. Performs other operational functions that are required in a computer center, such as loading a disk drive, placing cards in the card reader, removing printouts from the line printer rack, and sometimes bursting and decollating.

## computer output microfilm (COM)

Technology that involves recording computer output on microfilm or microfiche, either online directly from the computer or offline from magnetic tape. Contrast with *computer input microfilm*.

## computer output microfilm (COM)

**recorder** Device that records computer output on photosensitive film in microscopic form.

**computerphobia** Fear of computers, especially an inordinate fear.

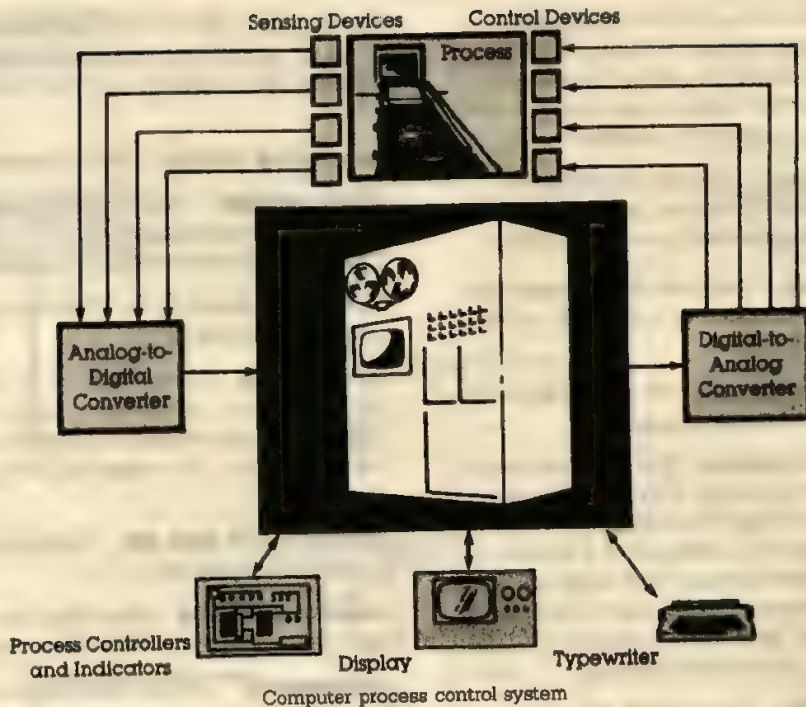
**computer process control system** System that uses a computer connected to sensors that monitor a process in order to control that process and its modification so that a product can be produced at a profit.

**computer processing cycle** (1) Steps involved in using a computer to solve a problem: write the program in a programming language such as BASIC or FORTRAN; input the program into the computer; compile and execute the program. (2) Basic processing cycle of input, process, and output.

**computer program** Formal expression of the sequence of actions required for a data processing task. The programmer's specification of the task(s) to the computer in a formal notation that can be processed by the computer. Consists of a series of statements and instructions that cause a computer to perform a particular operation or task.

**computer programmer** Person whose job is to design, write, and test programs and the instructions that cause a computer to do a specific job. See *coder* and *parts programmer*.





**computer revolution** See *information revolution*.

**computer science** Field of knowledge embracing all aspects of the design and use of computers. Offered as a degree program in many colleges and universities.

**computer security** Preservation of computing resources against abuse or unauthorized use, especially the protection of data from accidental or deliberate damage, disclosure, or modification. See *data security*.

**computer services company** Company that provides computer services to other individuals and organizations. Sometimes called *service bureau*. See *computer utility*.

**computer simulation** Representation of a real or hypothetical system, constructed from a computer program.

**computer specialist** Individual, such as a

```
begin
  for I: 1 TO 100 do
    begin
      total: = total + 1;
    end;
  end;
```

Computer program

systems analyst or a programmer, who provides computer services to computer-using organizations, usually as an independent contractor or *consultant*.

**computer store** Retail store where customers can select, from the shelf or the floor, a full

## computer system

computer system or just a few accessories. These stores typically sell software, books, supplies, and periodicals. In a broad-based computer store, one can examine and operate several types of microcomputer systems.

**computer system** System that includes computer hardware, software, and people. Used to process data into useful information.

**ComputerTown** California organization that promotes *computer literacy* and public access to small computers.

**computer user** Any person who uses a computer system or its output.

**computer users group** Group whose members share the knowledge they have gained and the programs they have developed on a computer or class of computers of a certain manufacturer. Most groups hold meetings and distribute newsletters to exchange information, trade equipment, and share computer programs.

**computer utility** Service that provides computational ability, usually a time-shared computer system. Programs, as well as data, may be made available to the user. The user also may have her or his own programs immediately available in the central processing unit, or have them on call at the computer utility, or load them by transmitting them to the computer prior to using them. Certain data and programs are shared by all users of the service; other data and programs, because of their proprietary nature, have restricted access. Computer utilities are generally accessed by means of data communications subsystems. See *computer services company* and *service bureau*.

**computer vendor** Organization that manufactures, sells, or services computer equipment

**computer word** Fixed sequence of bits, bytes, or characters treated as a unit and capable of being stored in one storage location. See *word*.

**computing** Act of using computing equipment for processing data. Art or science of getting the computer to do what the user wants.

**computing system** See *computer system*.

**COM recorder** Device that records computer output on photosensitive film in microscopic form. See *computer output microfilm*.

**COMSAT** Acronym for *COMMunications SATellite Corporation*.

**concatenate** To link together or join two or more character strings into a single character string, or to join one line of a display with the succeeding line. To compress. Contrast with *decatenate*.

**concatenated data set** Collection of logically connected data sets

**concatenated key** More than one data item used in conjunction to identify a record.

**concentrator** Device that allows a number of slow-speed devices to utilize a single high-speed communications line. Also called *multiplexer*. See *time-division multiplexer*.

**conceptual tool** Tool for working with ideas instead of things.

**concordance** Alphabetical list of words and phrases appearing in a document, with an indication of where those words and phrases appear.

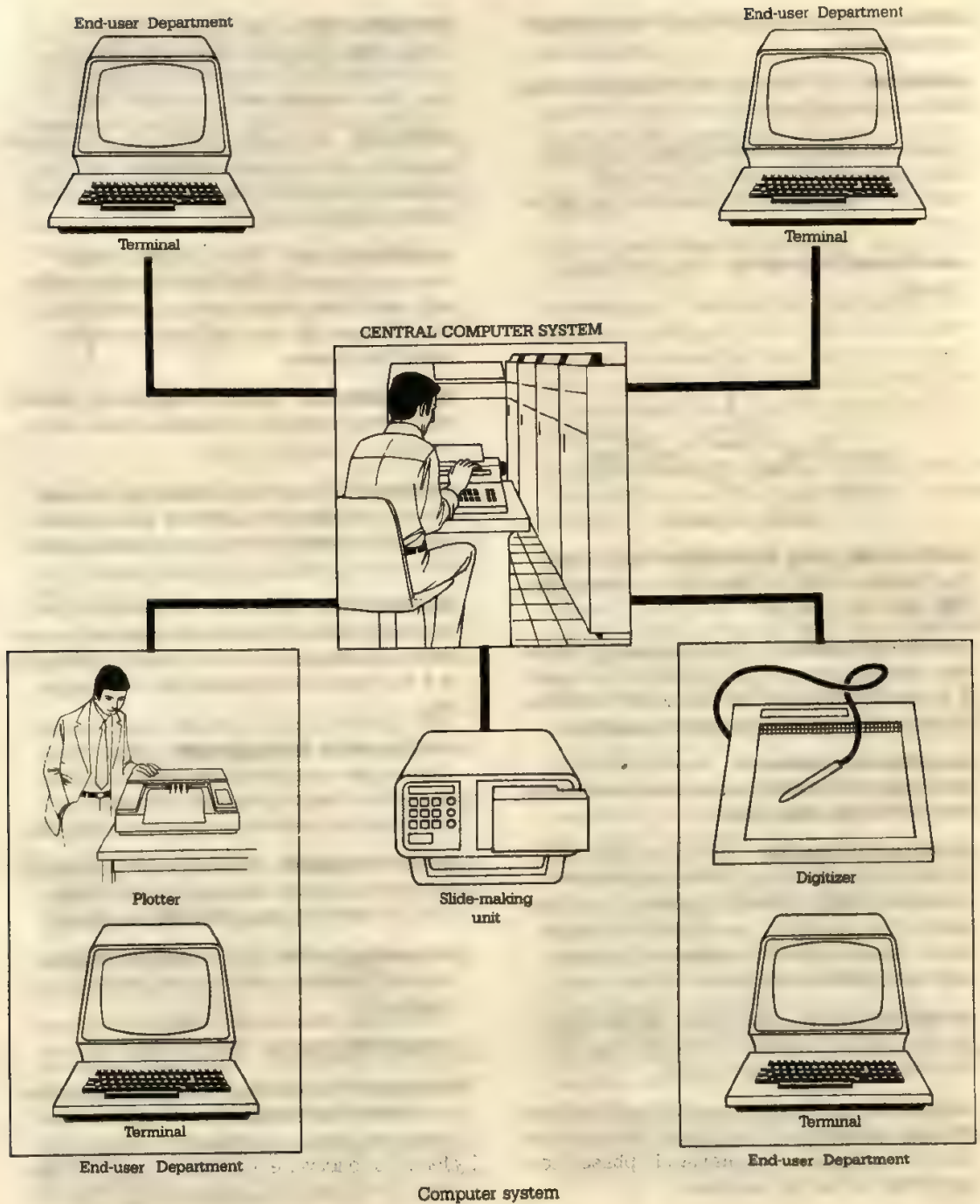
**concurrent** Pertaining to the occurrence of two or more events or activities within the same specified interval of time.

**concurrent processing** Performance of two or more data processing tasks within a specified interval. Contrast with *simultaneous processing*.

**concurrent program execution** Two or more programs being executed at the same time.

**concurrent programming** Development of





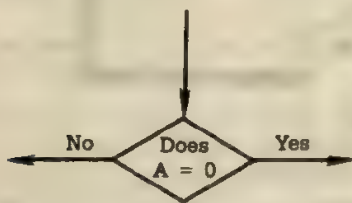
## condition

programs that specify the parallel execution of several tasks.

**condition** (1) Given set of circumstances. (2) Definite state of being.

**condition code** Limited group of program conditions—such as carry, borrow, and overflow—pertinent to the execution of instructions.

**conditional branching** See *conditional transfer*.



Conditional branch

**conditional jump instruction** Instruction that causes a *jump* to occur if the criteria specified are met. See *trap*.

**conditional paging** Word processing feature that causes printing to begin on the next page if a specified block of text will not fit completely within the remaining space on a page.

**conditional statement** Statement that is executed only when a certain condition within the routine has been met.

**conditional transfer** Instruction that may cause a departure from the sequence of instructions being followed, depending upon the result of an operation, the contents of a register, or the settings of an indicator. Contrast with *unconditional transfer*.

**condition entry** One of four sections of a decision table. Answers all questions in the *condition stub*. See *action entry*.

**conditioning** Improvement of the data transmission properties of a voiceband transmission line by correction of the amplitude phase characteristics of the line amplifiers.

**condition stub** One of four sections of a decision table. Describes all factors (options) to be considered in determining a course of action. See *condition entry* and *action stub*.

**CONDUIT** Nonprofit publisher of educational software. Reviews, tests, packages, and distributes instructional computer programs and related printed materials.

**conference tree** Type of bulletin board structured around topics and user comments, with each main branch being a broad topic that the user can then elaborate on as the branch lengthens.

**confidentiality** Quality of protection against unauthorized access to private or secret information.

**configure** To assemble a selection of hardware or software into a system and to adjust each of the parts so that they all work together.

**configuration** Assembly of machines that are interconnected and are programmed to operate as a system. Layout or design of elements in a hardware or information processing system.

**configuration management** Task of accounting for, controlling, and reporting the planned and actual design of a product throughout its production and operational life.

**connected graph** Graph formed by moving from a single node in a graph to any other node by traveling via a sequence of edges.

**connecting cable** Cable used to transfer electrical impulses between two pieces of equipment.

**connection matrix** See *incidence matrix*.

**connector** (1) Coupling device that provides an electrical and/or mechanical junction between two cables, or between a cable and a chassis or enclosure. (2) Device that provides rapid connection and disconnection of electri-



cal cable and wire terminations. See *female connector*, *jack*, *male connector*, *plug*, and *DB-25 connector*.

**connector symbol** *Flowcharting* symbol used to represent a junction in a line of flow. A small circle, possibly containing some identifier, connects broken paths in the line of flow on the same page. A pentagonal shape connects the flow on different pages of the same flow-chart. See *offpage connector*.



Connector symbols

**connect time** In time-sharing, the length of time you are "on" the computer; duration of the telephone connection. Usually measured by the duration between *sign-on* and *sign-off*. See *CPU time*.

**consecutive** Pertaining to the occurrence of two sequential events without the intervention of any other such event.

**consistency check** Check to ensure that specific input data fall within a predetermined set of criteria. Control method wherein like data items are checked for consistency of value and form.

**console** That part of a computer system that enables human operators to communicate with the system. See *front panel*.

**console operator** Same as *computer operator*.

**console printer** See *console typewriter*.

**console typewriter** Typewriter online to the computer that allows communication between the machine and the *computer operator*.

**constant** Value that does not change during the execution of the program. Also called *literal*. Contrast with *variable*.

**constraint** Condition that limits the solutions to a problem.

**consultant** Expert in the use of computers in specific applications environments, such as business data processing, education, military systems, or health care. Often helps to analyze and solve a specific problem. See *computer specialist*.

**content-addressable memory** Same as *associative storage*.

**contention** Condition on a multipoint communications channel when two or more locations try to transmit at the same time. Also occurs when two CPUs attempt to control the same device at once. See *tie-breaker* and *deadlock*.

**contents directory** Series of queues that indicate the routines in a given region of internal storage.

**context sensitive help key** Success key available on many video display terminals. When this key is pressed on a keyboard, help specific to the problem at hand is automatically displayed on the screen.

**contiguous** Adjacent or adjoining.

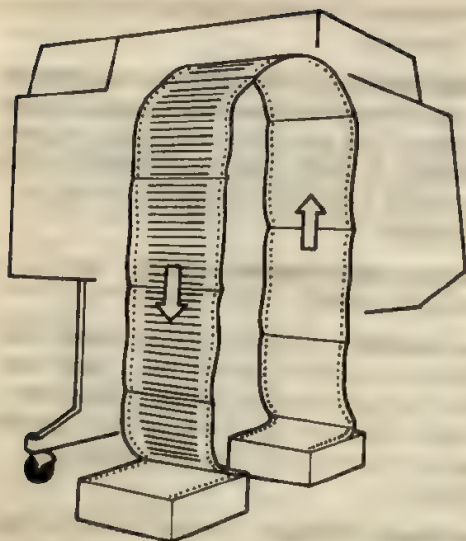
**contiguous data structure** See *sequential data structure*.

**contingency plan** Plan for recovery of a computer information system following emergencies or disasters.

**continuation card** Punched card that contains information that was started on a previous punched card.

**continuous forms** Fanfold paper or roll paper that has small holes on the outer edges for automatic feeding into printers. Can be blank sheets or preprinted forms such as checks, invoices, or tax forms. See *tractor-feed mechanism*. (See page 64.)

**continuous processing** Input of transactions into a system in the order they occur and as soon after they occur as possible.



Continuous forms

**continuous scrolling** Moving text, line by line, forward or backward, through a window.

**continuous-tone image** Color or black-and-white image formed of combinations of separate areas made up of different color tones or gray tones.

**contour analysis** Technique in *optical character recognition* that uses a spot of light to search for the outline of the character by moving around its exterior edges.

**contouring** In computer graphics, the creation of the outline of a body, mass, or figure.

**contrast** In *optical character recognition*, the differences between color or shading of the printed material on a document and the background on which it is printed.

**contrast enhancement** Improvement of light-to-dark distinctions. A real digitizing process typically involves some kind of nonlinear detector that destroys the light-to-dark relationships of the object scanned. Correct contrast can be reintroduced if the characteristics of the detector are known. Contrast can even be heightened if desired.

**control** Function of performing required operations when certain specific conditions occur or when interpreting and acting upon instructions. See *control section* and *control unit*.

**control block** Storage area through which a particular type of information required for control of the operating system is communicated among its parts.

**control break** Point during program processing at which some special processing event takes place, based upon change in value of a *control field*.

**control bus** In a computer, the path linking the CPU's control register to memory.

**control cards** Punched cards that contain input data required for a specific application of a general routine, such as a generator or operating system; for example, one of a series of cards that directs an operating system to load and initiate the execution of a particular program. See *job control language*.

**control character** Character whose occurrence in a particular context initiates, modifies, or stops a control operation.

**control circuits** Electrical circuits within a computer that interpret the program instructions and cause the appropriate operations to be performed.

**control clerk** Person who has responsibility for performing duties associated with the control over data processing operations.

**control console** That part of a computer system used for communication between the console operator or service engineer and the computer.

**control data** One or more items of data used as a control to identify, select, execute, or modify another routine, record, file, operation or data value.

**Control Data Corporation** Large manufac-



turer of computer equipment, including super-computers.

**control field** Field in a data record used to identify and classify the record. Same as *key*

**control key** Special-function key on a computer keyboard. Used simultaneously with another key to enter a command instructing the system to perform a task.

**controlled variable** Variable that takes on a specific set of values in an iterative structure in a programming language

**controller** Device required by the computer to operate a peripheral component.

**control logic** Order in which processing functions will be carried out by a computer

**control panel** (1) That part of a computer control console that contains manual controls (2) Hard-wired *plugboard* used to control the operations of unit record devices. Same as *front panel*.

**control program** Operating system program responsible for the overall management of the computer and its resources.

**control punch** Specific code punched in a card to cause the machine to perform a specific operation.

**controls** Methods and procedures for ensuring the accuracy, integrity, security, reliability, and completeness of data or processing techniques.

**control section** That part of the central processing unit responsible for directing the operation of the computer in accordance with the instructions in the program. Same as *control unit*.

**control sequence** Normal order of selection of instructions by a digital computer wherein it follows one instruction order at a time

**control signal** Computer-generated signal

for automatic control of machines and processes.

**control statement** Operation that terminates the sequential execution of instructions by transferring control to a statement elsewhere in the program.

**control station** Network station that supervises control procedures, such as *addressing*, *polling*, selecting, and recovery. Also responsible for establishing order on the line in the event of *contention* or any other abnormal situation.

**control structures** Facilities of a programming language that specify a departure from the normal sequential execution of statements.

**control total** Accumulation of numeric data fields that are used to check on the accuracy of the input, processed data, or output data.

**control unit** Portion of the central processing unit that directs the step-by-step operation of the entire computing system. Also called *control section*.

**control words** Series of reserved character sequences that have a special meaning to the program that reads them. See *reserved words*.

**convention** Standard and accepted procedures in computer program development and the abbreviations, symbols, and their meanings as developed for particular programs and systems. Any programming style rule, providing consistency among different programs.

**conversational** Pertaining to a program or a system that carries on a dialogue with a terminal user, alternately accepting input and then responding to the input quickly enough for the user to maintain his or her train of thought. See *interactive processing*.

**conversational interaction** Interaction with a computer that takes the form of a dialogue between the user and the machine.

**conversational language** Programming lan-

## conversational mode

guage that uses a near-English character set that facilitates communication between the user and the computer. BASIC is a conversational language.

**conversational mode** Mode of operation that implies a dialogue between a computer and its user in which the computer program examines the input supplied by the user and formulates questions or comments that are directed back to the user. See *interactive processing*, *logging-in*, and *transaction-oriented processing*.

**conversational operation** Transmission of data between a video display terminal and a computer in which data travels one character at a time. See *serial operation*.

**conversational remote job entry** See *CRJE*.

**conversational system** See *interactive system*.

**conversion** (1) Process of changing information from one form of representation to another, such as from the language of one type of computer to that of another or from punch cards to magnetic disk. (2) Process of changing from one data processing method to another or from one type of equipment to another. (3) Process of changing a number written in one base to the base of another numeral system.

**conversion table** Table comparing numerals in two different numeral systems.

**convert** (1) To change data from radix to radix. (2) To move data from one type of storage to another, such as from floppy disk to magnetic tape. See *transform*.

**converter** (1) Device that converts data recorded on one medium to another medium, such as a unit that accepts data from punched cards and records it on magnetic disks. (2) Device that converts data in one form into data in another form, such as from analog to digital. See *modem*.

Decimal	Binary	Hexadecimal	Octal
0	00000	0	0
1	00001	1	1
2	00010	2	2
3	00011	3	3
4	00100	4	4
5	00101	5	5
6	00110	6	6
7	00111	7	7
8	01000	8	10
9	01001	9	11
10	01010	A	12
11	01011	B	13
12	01100	C	14
13	01101	D	15
14	01110	E	16
15	01111	F	17
16	10000	10	20

Conversion table

**cookbook** Step-by-step document describing how to install and use a program.

**coordinate indexing** (1) System of indexing individual documents by descriptors of equal rank so that a library can be searched for a combination of one or more descriptors. (2) Indexing technique whereby the interrelationships of terms are shown by coupling individual words.

**coordinate paper** Continuous-feed graph paper used for graphs or diagrams produced on a digital plotter.

**coordinates** (1) Ordered set of absolute or relative data values that specify a location in a *Cartesian coordinate system*. (2) In an electronic spreadsheet, the intersection of two numbers and/or letters that uniquely identify the column and row of a cell. (3) Two numbers used to position the cursor, or pointer, on the screen.

**coprocessor** Auxiliary processor that performs time-consuming tasks to free the central processing unit, thus resulting in faster execution time for the overall system. A CPU that works in tandem with another to increase the computing power of a system. An *intelligent terminal* often performs as a coprocessor.



**copy** To reproduce data in a new location or other destination, leaving the source data unchanged, although the physical form of the result may differ from that of the source; for example, to make a duplicate of all the programs or data on a disk. Contrast with *duplicate*.

**copy holder** Device used to hold papers so the user can easily read them when typing on a keyboard. Its purpose is to reduce back, shoulder, neck, and eye strain.

**copy protection** Methods used by software developers to prevent any copying of their programs. To protect against illegal copying of software, most manufacturers build copy-protection routines into their programs. Copy-protection techniques are sometimes sophisticated, although several commercial programs exist that allow users to override many standard copy-protection techniques.

**core storage** Form of storage device that utilizes magnetic cores usually strung through wires in the form of an array. Used in older computers. See *magnetic core storage*.

**corner cut** Diagonal cut at the corner of a *punched card*. Used as a means of identifying groups of related cards.

**coroutine** Instructions used to transfer a set of inputs to a set of outputs.

**corporate model** Mathematical representation or simulation of a company's accounting practices and financial policy guidelines. Used to project financial results under a given set of assumptions and to evaluate the financial impact of alternative plans. Long-range forecasts are also calculated by using such models. Such a model would ideally be put into an "equation processor," but spreadsheets are often used.

**corrective maintenance** Activity of detecting, isolating, and correcting failures after they occur. Contrast with *preventive maintenance*.

**correspondence quality** High-quality printing obtained by daisy wheel and certain dot

matrix printers. The high-resolution mode of a dot matrix printer is used to improve print quality by increasing the number of dots used to form the characters. See *letter quality*. Contrast with *draft quality*.

**cost analysis** Technique used to determine the overall costs of a given system and to compare them to cost factors estimated for a new design.

**cost/benefit analysis** Quantitative form of evaluation in which benefits are assessed and costs associated with achieving the benefits are determined.

**cost-effectiveness** Effectiveness of a system or an operation in terms of the relationship of the benefits received to the resources expended to attain them. A system in which the received benefits exceed the associated costs is considered cost-effective.

**costing** Method of assigning costs to a project, job, or function.

**cottage key people** People who work at home and transmit work to the company by telecommunications, diskettes, or other means.

**coulomb** Base SI unit of electric charge. A group of  $6.25 \times 10^{18}$  electrons has a charge of 1 coulomb.

**count** Successive increase or decrease of a cumulative total of the number of times an event occurs.

**counter** Device, such as a register or computer storage location, used to represent the number of occurrences of an event.

**counting loop** Program loop used to perform some action a fixed number of times.

**coupling** Interaction between systems or between properties of a system.

**courseware** Name given to computer programs written especially for educational applications, such as teaching chemistry, history,

mathematics, Spanish, or reading skills. See *computer-assisted instruction*.

**cpi** Abbreviation for characters per inch. See *bytes per inch*.

**CPM** Acronym for Critical Path Method.

**CP/M** Acronym for Control Program for Microcomputers, a widely used *operating system* for microcomputers. A collection of programs on a diskette, CP/M provides specific commands for transferring information among the devices connected to the computer system, for executing programs, and for manipulating files conveniently. See *MP/M*, *MS—DOS* and *UNIX*.

**CP/M compatible** Pertaining to software designed to operate in conjunction with the CP/M operating system.

**cps** Abbreviation for *characters per second*.

**CPS** Acronym for Conversation Programming System, a computer system in which input and output are handled by a remote terminal. Employs time-sharing so the user obtains what appears to be an immediate response. Used more specifically as CPS-PL/I to mean an IBM-devised subset of the PL/I programming language used with remote terminals.

**CPU** Acronym for *Central Processing Unit*.

**CPU time** Amount of time devoted by the central processing unit to the execution of program instructions. See *connect time*.

**CR** Acronym for *Carriage Return*.

**crash** System shutdown caused by a hardware malfunction or a software mistake. See *head crash*.

**crash conversion** See *direct conversion*.

**Cray** Line of supercomputers manufactured by Cray Research, Inc., including the Cray 1—which can process 80 million instructions per second and has main storage for over one million characters—and the Cray 2, which can process a billion operations a second.

**Cray, Seymour** Designed and introduced the first supercomputer, the Cray 1, in 1980, followed five years later by the Cray 2 supercomputer. See *Cray*.



Seymour Cray

**CRC** Acronym for Cyclic Redundancy Check, a method for checking for errors in transmitted data.

**create** (1) To make a new file on a disk as opposed to modifying an existing file. (2) To define the fields for a database record, specifying field name, length, field type, and so on.

**crime, computer** See *computer crime*.

**critical path** That path through a network that defines the shortest possible time in which the entire project can be completed. See *critical path method* and *PERT*.

**critical path method (CPM)** Management technique for control of large-scale, long-term projects involving the analysis and determination of each critical step necessary for project completion. See *PERT*.

**CRJE** Acronym for Conversational Remote



**Job Entry**, a conversational language employed by a terminal user in submitting jobs to a central site and controlling their processing from a remote terminal station.

**CROM** Acronym for Control ROM, an integral part of most CPU chips. Storage for the *micro instructions* that the CPU assembles into a sequence to form the complex *macro instructions*, such as Multiply or Branch-On-Negative Accumulator, available to the computer user.

**cross-assembler** Assembler run on one computer for the purpose of translating instructions for a different computer.

**cross-check** To check the computing by two different methods.

**cross-compiler** Compiler that runs on a machine other than the one for which it is designed to compile code.

**cross-compiling/assembling** Technique whereby one uses a minicomputer, large-scale computer, or time-sharing service to write and debug programs for subsequent use on microcomputers.

**cross-footing check** Process of cross-adding, or subtracting, then zeroing-out the results.

**cross hairs** On an input device, two intersecting lines—one horizontal and one vertical—whose intersection marks the active cursor position of a graphics system.

**crosshatching** In computer graphics, the shading of some portion of a drawing with a pattern of intersecting lines or figures repeated across the area being shaded. Compare *hatching*.

**cross-reference dictionary** Printed listing that identifies all references of an assembled program to a specific label. In many systems, this listing is provided immediately after a source program has been assembled.

**cross talk** Unwanted energy transferred from

one circuit, called the "disturbing circuit," to another circuit, called the "disturbed circuit." Generally occurs when signals from one circuit emerge onto another circuit as interference.

**crowbar** Circuit that protects a computer system from dangerously high voltage surges.

**CRT** Acronym for *Cathode Ray Tube*, the picture tube of a video monitor. See *display unit*.

**CRT plot** Computer-generated drawing or graph projected onto the screen of a cathode ray tube.

**CRT terminal** (1) Visual display unit (VDU). (2) Display device with keyboard as used by an operator to communicate with a computer. As the operator types a message or text on the keyboard, the characters are displayed on the screen.

**crunch** Nontechnical term used by computer people to refer to the computer's capacity to process numbers and perform routine arithmetic functions. Computers can process, or crunch, a lot of numbers quickly. See *number cruncher*.

**cryoelectronic storage** Storage device consisting of materials that become superconductors at extremely low temperatures.

**cryogenics** Study and use of devices that utilize the properties assumed by materials at temperatures near absolute zero.

**cryosar** Two-terminal semiconductor switching device that operates at very low temperatures.

**cryotron** Current-controlled switching device based on superconductivity; used primarily in computer circuits.

**cryptanalysis** Operation of converting encrypted messages to the corresponding *plaintext* without initial knowledge of the key employed in the encryption.

**cryptographic techniques** Methods of con-

## cryptography

cealing data by representing each character or group of characters by others.

**cryptography** Any of various methods for writing in secret code or cipher. As society becomes increasingly dependent upon computers, the vast amounts of data communicated, processed, and stored within computer systems and networks often have to be protected, and cryptography is a means of achieving this protection. It is the only practical method for protecting information transmitted through accessible communications networks, such as telephone lines, satellites, or microwave systems. See *cypher*.

**crystal** Quartz crystal that vibrates at a specific frequency when energy is supplied to it. These vibrations provide an accurate frequency by which to time the clock within a computer system.

**CT** Acronym for computed tomographic. See *computerized axial tomography*.

**CTRL** Acronym for *control*.

**CUBE** Acronym derived from Cooperating Users of Burroughs Equipment, the official organization of the users of Burroughs' computers.

**cue** See *call*.

**CUE** Acronym for Computer Using Educators, a California organization that promotes computer education to teachers throughout the state.

**current** Flow of electrons through a conductor. Measured in amperes, where 1 ampere equals  $6.25 \times 10^{18}$  electrons per second.

**current awareness system** Process whereby a user is notified periodically by a central file or library when selected items of information have been acquired.

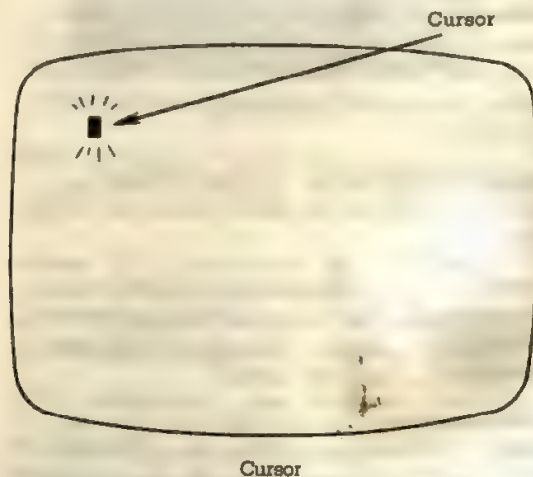
**current location counter** Counter kept by an assembler to determine the address that has been assigned to either an instruction or constant being assembled.

**current loop** Type of serial communication in which the presence or absence of an electrical signal indicates the state of the bit being transmitted.

**current mode logic (CML)** Logic circuit that employs the characteristics of a differential amplifier circuit in its design. See *ECL*.

**cursive scanning** Scanning technique used with video display terminals in which the electrons being sent toward the screen are deflected to form the outlines of the picture one line at a time in the same way an artist might draw the same image.

**cursor** (1) Moving, sliding, or blinking symbol on a CRT screen that indicates where the next character will appear. (2) Position indicator used on a video display terminal to indicate a character to be corrected or a position in which data is to be entered.

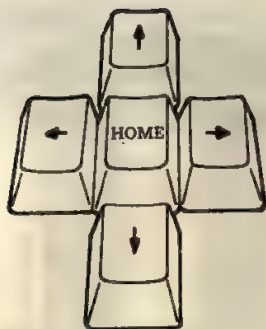


**cursor control** Ability to move a video display prompt character to any position on the screen.

**cursor control keys** Keyboard keys used to position the cursor on the display screen. Easiest to use when arranged in a compass pattern.

**cursor tracking** Positioning a cursor on a





Cursor control keys



Cursor tracking

display screen by moving a stylus on a *digitizer* connected to the computer.

**curve fitting** Mathematical technique for finding a formula that best represents a collection of data points. Usually the formula is used to plot the best-fit line through the points. Compare *fitting*.

**custodian** Person or organization responsible for physical maintenance and safeguarding of data stored on disk packs, tape reels, and so forth. See *librarian*.

**customer engineer (CE)** Individual responsible for field maintenance of computer hardware and software. Also called *field engineer*.

**custom IC** Integrated circuit (IC) manufac-

tured to a specific customer's design and specification.

**customize** Process of altering a piece of general-purpose software or hardware to enhance its performance, usually to fit a specific user's need.

**customized form letters** Personalized form letters produced by word processing systems and special form-letter programs.

**custom software** Programs prepared specifically for a business or organization and tailored to the business's needs. Contrast with *canned software*.

**cut** Act of removing text or graphics from a document. Compare *paste*.

**cut-and-paste** Method employed by some word processing and graphic systems to move text from one location to another. Such systems usually permit the performance of other operations between the *cut* and the *paste* steps. Abbreviated *cut 'n' paste*.

**cut form** Data-entry form, such as a utility bill, used by OCR devices.

**cut-sheet feeder** Device that feeds sheets of paper to the printer, one at a time. Usually a *friction-feed device*.

**cutter path** Line described by the motion of a cutting tool controlled by a computer-aided manufacturing system.

**cyan** Shade of blue frequently used on VDTs for color graphics.

**Cyber** Line of supercomputers and mainframes manufactured by Control Data Corporation.

**cybernetics** Branch of learning that seeks to integrate the theories and studies of communication and control in machines and living organisms. See *artificial intelligence* and *Wiener, Norbert*.

**cyborg** Human with an electronic or electromechanical robot part.

## cycle

**cycle** As related to computer storage, a periodic sequence of events occurring when information is transferred to or from the storage device or a computer. Time it takes to reference an address, remove the data, and be ready to select it again.

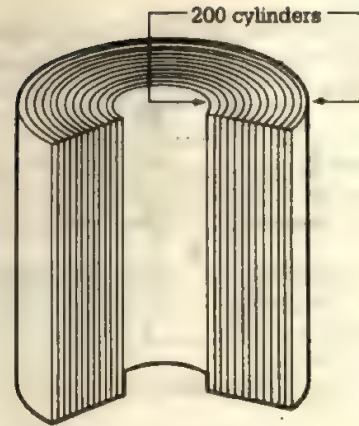
**cycle stealing** Technique that allows a peripheral device temporarily to disable computer control of the I/O bus, thus allowing the device to access the computer's internal memory.

**cycle time** (1) Minimum time interval between the starts of successive accesses to a storage location. (2) Time required to change the information in a set of registers.

**cyclic code** Same as *gray code*.

**cyclic redundancy check (CRC)** Error-detection scheme often used in disk devices. When data are stored, a CRC value is computed and stored. Whenever it is reread, the CRC value is computed once again. If the two values are equal, the data is assumed to be error-free.

**cyclic shift** Shift in which the digits dropped off at one end of a word are returned at the other in a circular fashion. If a register holds eight digits, 23456789, the result of the cyclic shift two columns to the left would be to change the contents of the register to 45678923.



Cylinder

**cylinder** As related to magnetic disks, a vertical column of tracks on a magnetic disk pack. The corresponding tracks on each surface of a disk pack.

**cylinder method** Method or concept that data on all tracks above and below the one currently being used are available by merely switching read/write heads. Allows access to large amounts of information with no extra movement of the access device.

**cypher** Form of *cryptography* in which the *plaintext* is made unintelligible to anyone who intercepts it by a transformation of the information itself, based on some key.



# D

**DA** Acronym for *Direct Access*.

**D-A converter** See *digital-to-analog converter*.

**daisy chain** Specific method of propagating signals along a bus that permits the assignment of device priorities based on the electrical position of the device along the bus.

**daisy wheel** Printing element in a *daisy wheel printer*. Characters are embossed on spokes radiating from a central hub.

**daisy wheel printer** Printer that uses a metal or plastic disk with printed characters along its edge. The disk rotates until the required character is brought before a hammer that strikes it against a ribbon. Popular *letter-quality printer* used with personal computers.

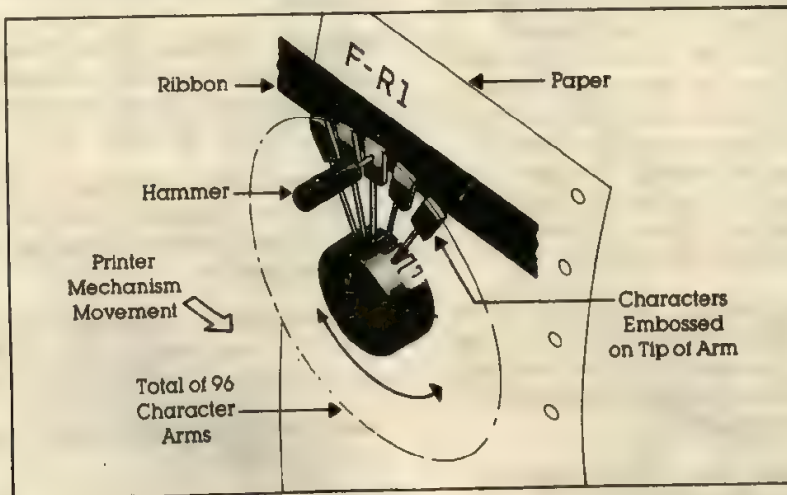
**dark bulb** Type of cathode ray tube, almost black in appearance when turned off, that gives good contrast to video displays.

**darkness** Intensity, especially low *intensity* or limited *brightness*.

**DASD** Acronym for *Direct Access Storage Device*.

**DAT** Acronym for *Dynamic Address Translation*.

**data** Formalized representation of facts or concepts suitable for communication, interpretation, or processing by people or by automatic means. Raw material of information. Individual pieces of quantitative information, such as dollar sales of carpets, numbers of building per-



Daisy wheel

## data acquisition

mits issued, units of raw material on hand. Historically, data is a plural noun while datum is singular—a distinction now generally ignored in data processing terminology.

**data acquisition** Retrieval of data from remote sites initiated by a central computer system. Collection of data from external sensors.

**data administrator** See *database administrator*.

**data aggregate** Any collection of data items within a record that is given a name and referred to as a whole, such as an array

**data bank** (1) Comprehensive collection of libraries of data. (2) Loosely, a *database*.

**database** Most generally, any clearly identified collection of data, such as a telephone book or the card catalog at a library. In theory, a database should contain all its information in one central store or file, each record in the file containing roughly the same type of information—such as name, address, city, state, zip code, area code, and telephone number. Each of these categories is called a *field*, while a *record* consists of a set of fields pertaining to one person or item. The *database file* is made up of a number of related records. Some people differentiate between a data base (two words), meaning an underlying collection of data in the real world, and a database (single word) as a coherent collection of data entered into a computer system. As applied to data in the computer, it particularly means data organized so that various programs can access and update the information.

**database administrator** Person responsible for the creation of the information system database and, once it is established, for maintaining its security and developing procedures for its recovery from disaster.

**database analyst** Key person in the analysis, design, and implementation of data structures in a database environment.

**database environment** That environment resulting from the integration of users, data, and systems by implementing the database.

**database management** Systematic approach to storing, updating, and retrieving of data items, usually in the form of records in a file, by which many users, or even many remote installations, will use common data banks.

**database management system (DBMS)** Collection of hardware and software that organizes and provides access to a database. The computer program provides the mechanisms needed to create a computerized database file, to add data to the file, to alter data in the file, to organize data within the file, to search for data in the file, and so forth. In other words, it manages data. Compare *file manager*.

**database manager** Program that allows the user to enter, organize, sort, and retrieve information.

**database packages** See *database management system*.

**database specialist** Person who works with databases.

**data bus** *Bus system* that interconnects the CPU, storage, and all the input/output devices of a computer system for the purpose of exchanging data. (See page 76.)

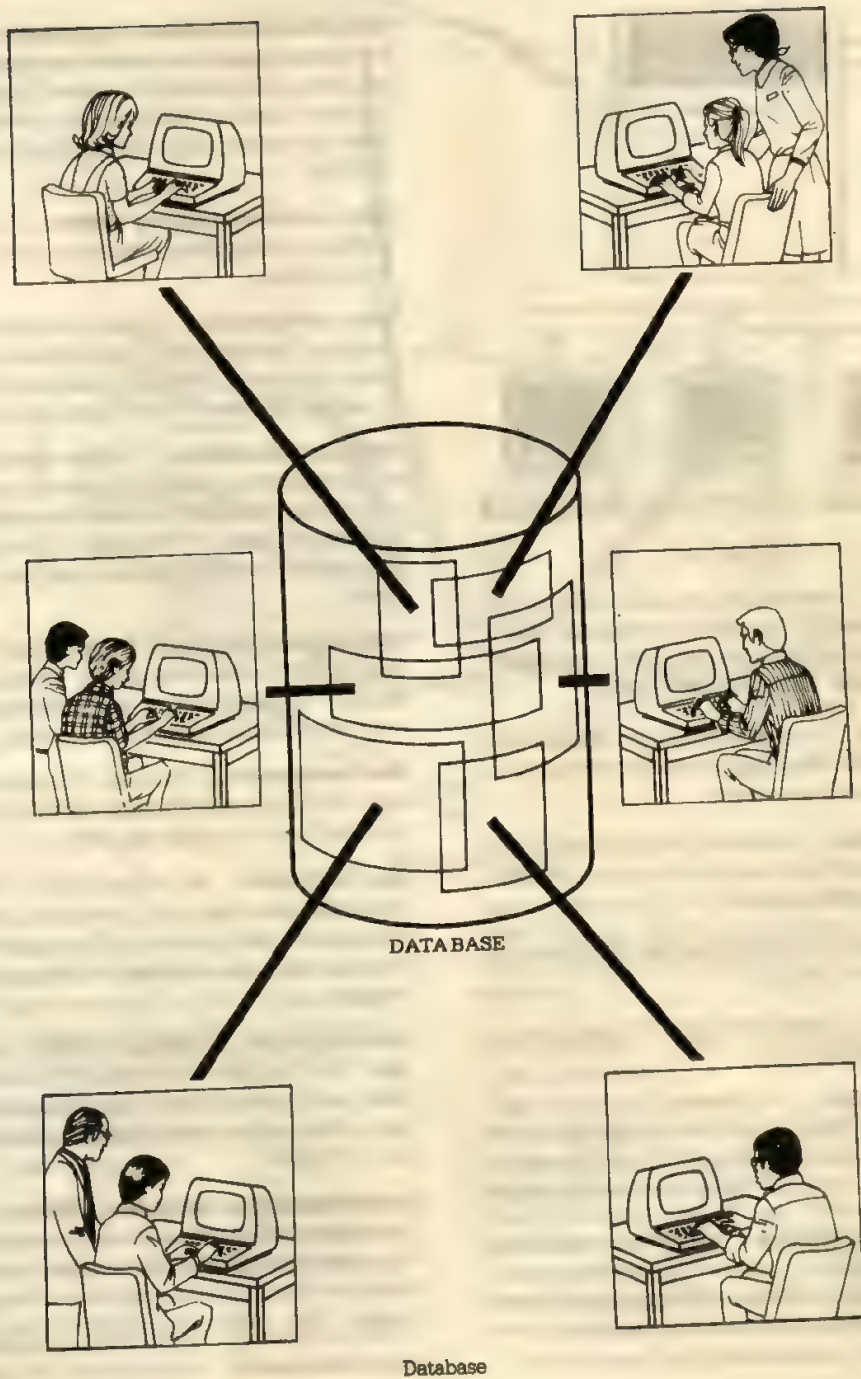
**data byte** Eight-bit binary number representing one character of data the computer will use in an arithmetic or logical operation, or store in memory

**data capturing** Gathering or collecting information for computer handling, the first step in job processing. Also called *data collection*.

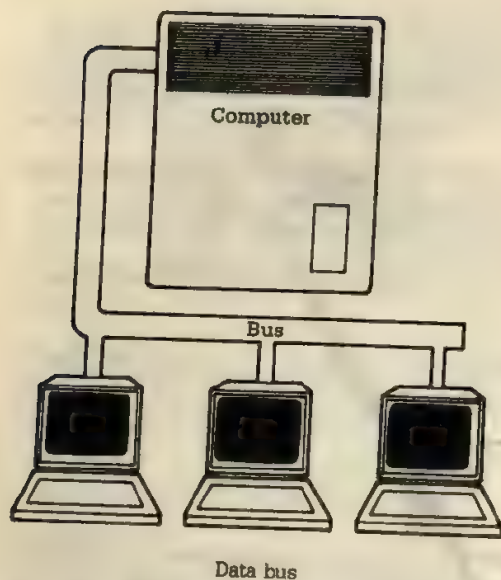
**data card** Punched card that contains one or more data items.

**data catalog** Organized listing by full name of all data elements used by an organization.





data cell



**data cell** Direct access magnetic storage device developed by the IBM Corporation, that handles data recorded on magnetic strips arranged in cells. See *magnetic card*.

**data center** Computer-equipped location that processes data and converts it into a desired form, such as reports.

**data chaining** Process of linking data items together. Each data item contains the location of the next data item.

**data channel** Communications *link* between two devices or points.

**data clerk** Person who does clerical jobs in a computer installation.

**data collection** (1) Gathering of source data to be entered into a data processing system. Also called *data capturing*. (2) Act of bringing data from one or more points to a central point.

**data communications** (1) Movement of encoded information by means of electrical transmission systems. (2) Entire process and science of enabling digital devices, such as computers, to communicate with each other.

### **data communications equipment**

Equipment associated with the transmission of data from one device to another. Examples are *modems*, *remote terminals*, and *communications processors*. See *input/output channel* and *RS-232C*.

**data communications system** System consisting of computers, terminals, and communications links.

**data compression** Technique that saves computer storage space by eliminating empty fields, gap redundancies, or unnecessary data to reduce the size or the length of records.

**data concentration** (1) Collection of data at an intermediate point from several low- and medium-speed lines for retransmission across high-speed lines. (2) Addition of one item at the end of others to produce one longer data item.

**data control section** Organization or group responsible for meeting quality control standards for processing and for collecting input from, and delivering output to, computer users.

**data conversion** Process of changing the form of data representation, such as from punched card to magnetic disk.

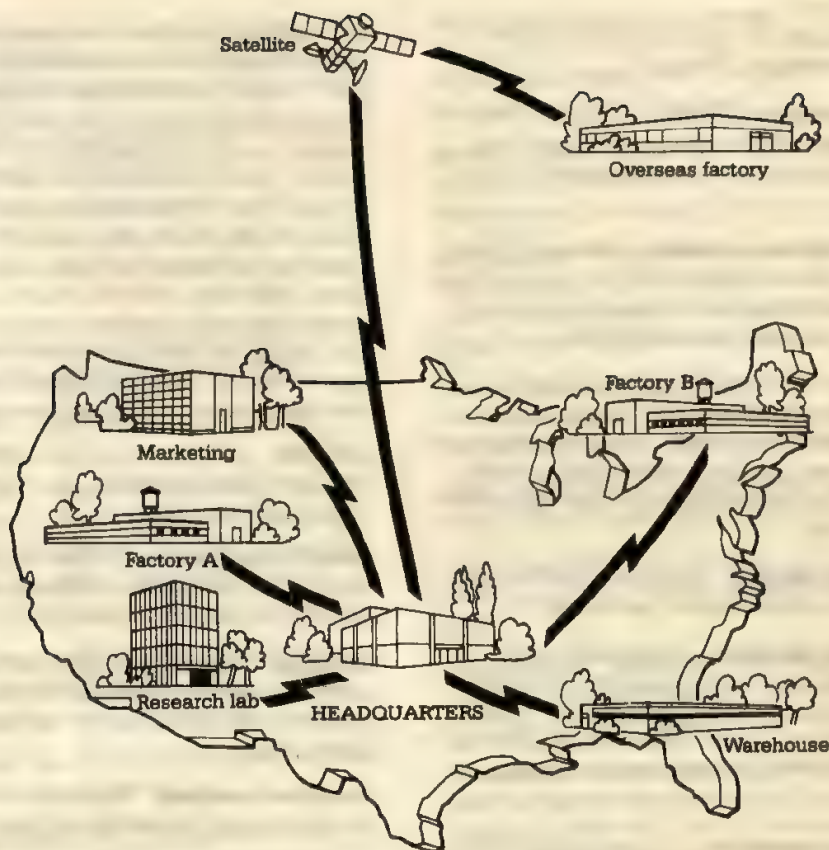
**data definition** In programming, a statement that gives the size, type, and often the content of a field or record. That portion of a program that identifies the data to be used in analysis.

**data definition language (DDL)** Language used by a database administrator to create, store, and manage data in a database environment. Also called *data description language*. See *SCHEMA*.

**data description language (DDL)** Language that specifies the manner in which data are to be stored and managed in a database environment by a database management system. Also called *data definition language*.

**data dictionary** List of all the files, fields,





Data communications

and variables used in a database management system. A data dictionary helps users remember what items they have to work with and how they have been defined. Particularly helpful when writing a large number of linked procedures or programs that share a database.

**data diddling** Technique whereby data is modified before it goes into a computer file where it is less accessible.

**data directory** Ordered collection of data element names and/or identifiers and their attributes that provides the location of the elements.

**data directory/dictionary** Ordered collec-

tion of data elements that combines the features of a *data catalog*, *data dictionary*, and *data directory*. Describes and locates each data element.

**data division** Third of four main parts of a *COBOL* program.

**data editing** Procedure to check for irregularities in input data. Typical checks are a *range check*, *reasonableness check*, and checks to determine whether data is properly alphabetic or numeric, as required. See *edit*.

**data element** Combination of one or more data items that forms a unit or piece of infor-

## data encryption

mation, such as the social security number in an employee/payroll database.

**data encryption** Coding technique used to secure sensitive data by mixing or jumbling the data according to a predetermined format. See *cipher*.

**data encryption standard** Method of data protection, developed by IBM and accepted by the National Bureau of Standards, that uses a single "private key" to encrypt data.

**data entry** (1) Process of converting data into a form suitable for entry into a computer system, such as by keying from a terminal onto magnetic disk or tape, or keypunching cards. (2) Process of entering data directly into a computer system.

**data entry device** Equipment used to prepare data so the computer can accept it.

**data entry operator** Person who uses a keyboard device to transcribe data into a form suitable for processing by a computer. Often a member of a computer operations staff who is responsible for keying data into a computer system.

**data entry specialist** Person responsible for inputting information into the computer for processing.

**data export** Capacity to transport (write) information from one database in a form that can be used (read) by another program, such as a word processor for form letters and reports, a spreadsheet, or a different database. Opposite of *data import*.

**data field** (1) One column or consecutive columns on a coding form or punched card used to record a particular piece of data. (2) Part of a data record.

**data field masking** Using special characters to offset or divide data fields. For date fields, the slash or hyphen characters are often used to divide the month, day, and year: 07/12/86.

For telephone numbers, the parentheses and hyphen characters may be desired: (999) 999-9999. Similar types of characters may be used for part numbers or in other fields where such offsets improve the readability of character strings. These masks can be inserted by the computer, so an operator does not have to enter the hyphen or other character manually. Only the numbers 071286 are entered in the above data field, with the slashes inserted automatically by the computer program. This feature greatly simplifies data entry and ensures standardization. Some programs routinely mask such fields as date and telephone number.

**data file** Collection of related data records that have been organized in a specific manner. Also called *text file*.

**data file processing** Updating of data files by adding, changing, or deleting records to reflect the effects of current data.

**dataflow** Generic term that pertains to algorithms or machines whose actions are determined by the availability of the data needed for these actions.

**dataflow analysis** Study of the movement of data among processing activities.

**dataflow diagram** Graphic systems analysis and design tool that enables a systems analyst to represent the flow of data through a system. See *system flowchart*.

**data gathering** Task of collecting data from internal and/or external sources. See *data collection*.

**Data General Corporation** Large manufacturer of minicomputer systems. See *NOVA*.

**data import** Ability to use (read) information developed with another program. Particularly important in the use of integrated software where several programs will use the information gathered or produced by one program. Opposite of *data export*.

**data independence** Status of a database



system with storage structure and accessing strategy that can be changed without significantly affecting the application.

**data integrity** Performance measure based on the rate of undetected errors. See *integrity*.

**data interchange format (DIF)** Standard among software developers that allows data from one program to be accessible to another program.

**data item** Item of data used to represent a single value. Smallest unit of named data.

**data leakage** Illegal removal of data from a computer facility.

**data librarian** Person who maintains custody and control of disks, tapes, and procedures manuals by cataloging and monitoring the use of these data resources. Often called *tape librarian* or *custodian*.

**data link** Equipment that permits the transmission of information in data format. See *channel*.

**data logging** Recording of data about events that occur in time sequence.

**data management** (1) General term that collectively describes those functions of a system that provide access to hardware, enforce data storage conventions, and regulate the use of input/output devices. (2) Major function of operating systems that involves organizing, cataloging, locating, retrieving, storing, and maintaining data.

**data management system** (1) System that provides the necessary procedures and programs to collect, organize, and maintain the data required by information systems. (2) System that assigns the responsibility for data input and integrity to establish and maintain the databases within an organization.

**data manipulation** Process of using language commands to add, delete, modify, or retrieve data in a file or database.

### **data manipulation language (DML)**

Language that allows a user to interrogate and access the database of a computer system by using English-like statements.

**data medium** Material in or on which a specific physical variable may represent data, such as magnetic disk or magnetic tape.

**data model** Formal language for describing data structures and operations on those structures. Usually divided into a *data description language* and a *data manipulating language*.

**data movement time** Time taken to transfer data to or from a disk once the read/write head is properly positioned on a disk track.

**data name** Name of the variable used to indicate a data value such as pi for 3.14159....

**data origination** Translation of information from its original form into machine-sensible form.

**data packet** Means of transmitting serial data in an efficient package that includes an error-checking sequence.

**Dataphone** Trademark of AT&T Company used to identify *data sets* manufactured and supplied by the Bell System for use in transmission of data over the telephone network.

**data point** Numeric value for charting purposes. In a simple line chart, time may be plotted across the X axis and another value against the Y axis, the intersection being a data point.

**data preparation** Process of organizing information and storing it in a form that can be input to the computer.

**data preparation device** Device that permits data capture in which the source data is collected and transformed into a medium or form capable of being read into a computer.

**Datapro** Research/publishing company that provides in-depth information about computer hardware and software products.

**data processing** (1) One or more operations performed on data to achieve a desired objective. (2) All functions of a computer center. (3) Operations performed by data processing equipment. (4) Operations performed on data to provide useful information to users.

**data processing center** Computer center equipped with devices capable of receiving information, processing it according to human-made instructions, and producing the computed results. Same as *information processing center*. Also called *operation center*.

**data processing curriculum** Course of study, normally offered by a business school or college, that prepares students for entry level jobs as applications programmers or systems analysts.

**data processing cycle** Combined functions of input, processing, and output.

**data processing management** Managing the data processing function, its people, and its equipment. Since this activity follows the well-recognized principles of planning, control, and operation, its basic prerequisites are the same skills that are needed to manage any other enterprise.

**Data Processing Management Association (DPMA)** Largest professional association in the field of computer management. Its purpose is to engage in education and research activities focused on the development of effective programs for the self-improvement of its worldwide membership of more than 32 000. Seeks to encourage high standards of competence and promotes a professional attitude among its members. Sponsors high school clubs and college chapters.

**data processing manager** Person who runs the data processing center, usually including the operation of the computer. The biggest part of the manager's job is concerned with developing new systems and keeping them running.

**data processing system** Network of data processing hardware, software, people, and procedures capable of accepting information, processing it according to a plan, and producing the desired results.

**data processing technology** Science of information handling.

**data processor** Any device capable of performing operations on data, such as a desk calculator or a digital computer.

**data protection** Measures to safeguard data from undesired occurrences that intentionally or unintentionally lead to destruction, modification, or disclosure of data. See *data security*.

**data rate** Rate at which a channel carries data, measured in bauds (bits per second).

**data record** Collection of data fields pertaining to a particular subject. Part of a *data file*.

**data reduction** Process of transforming raw data into useful, condensed, or simplified intelligence. Often adjusting, scaling, smoothing, compacting, editing, and ordering operations are used in the process.

**data scope** Special display device that monitors a data communications channel and displays the content of the information being transmitted over it.

**data security** Protection of data from accidental or malicious destruction, disclosure, or modification. See *computer security*, *disk library*, and *tape library*.

**data set** (1) Device that permits transmission of data over communications lines by changing the form of the data at one end so it can be carried over the lines; another data set at the other end changes the data back to its original form so it is acceptable to the computer or other machine. See *Dataphone* and *modem*. (2) Collection of related data items, especially a grouping of related records, called a *file*.

**data sharing** Ability of computer processes



or of computer users at several nodes to access data at a single node.

**data sheet** Special form used to record input values in a format convenient for keypunching. See *coding form*.

**data sink** Memory or recording device capable of accepting signals from a data transmission device and storing data for future use.

**data source** Device capable of originating signals for a data transmission device.

**data storage device** Unit for storing thousands or millions of characters—typically, a magnetic disk, tape, drum, or card.

**data storage techniques** Methods used by a program to store data files.

**data stream** Serial data transmitted through a channel from a single input/output operation.

**data structure** Structure of relationships among files in a database and among data items within each file.

**data tablet** Manual input device for graphic display consoles. Same as *digitizer*.

**data terminal** Point in a computer system or data communications network at which data can be entered or retrieved. See *terminal* and *video display terminal*.

**data transfer operations** Operations that move data, whether externally through *data communications* or within main computer storage by copying from one location to another. See *move*.

**data transfer rate** Rate of transfer of data from one place to another, such as from computer main memory to disk or from one computer's memory to another computer's memory. See *bit transfer rate*.

**data transmission** Sending of data from one part of a system to another part. See *data communications*.

**data type** Interpretation applied to a string of bits, such as integer, real, or character.

**data validation** Measures taken to ensure that data fields conform to desired specifications. Fields may be checked for inappropriate characters or for deviation from specified lengths or values. See *edit*.

**data value** Any string of symbols that serves as the representative of some item of information.

**data word** Ordered set of characters, usually of a preset number, that is stored and transferred by the computer's circuits as a fundamental unit of information. See *word length*.

**data word size** Specific length of data word that a particular computer is designed to handle. See *word* and *word length*.

**datum** Unit of information, such as a computer word.

**daughter board** Circuit board that plugs into a *motherboard*.

**DB-25 connector** Plug with either 25 pins (male) or 25 slots (female). Most commonly used with an RS-232C interface connection.

**DBMS** Acronym for *Database Management System*.

**DC** Acronym for (1) *Data Conversion*, (2) *Design Change*, (3) *Digital Computer*, (4) *Direct Current*, (5) *Direct Cycle*, (6) *Display Console*.

**DCTL** Acronym for *Direct Coupled Transistor Logic*.

**DDD** Acronym for *Direct Distance Dialing*, the facility used for making long-distance telephone calls without the assistance of a telephone operator. Also used for *data communications*.

**DDL** Language for declaring data structures in a database. See *data definition language* and *data description language*.

## dead halt

**dead halt** Halt situation in which the system cannot return to the point at which it halted.

**dead letter box** In message switching systems, a file for capturing undeliverable messages.

**deadlock** Unresolved *contention* for the use of a resource.

**deallocation** Release of a resource by a program when the program no longer needs it. Opposite of *allocation*.

**debit card** Card issued by a specific bank that allows the user to deduct money directly from his/her bank account when making purchases in stores that have accounts with the same bank.

**deblocking** Extracting a logical record from a block or group of logical records.

**debounce** To prevent spurious closures of a key or switch from being recognized. One method is to introduce time delays that give the switch contacts time to settle down.

**debug** To detect, locate, and remove all mistakes in a computer program and any malfunctions in the computing system itself. Synonymous with *troubleshoot*. See *debugging*, *bug*, *debugging aids*, and *test data*.

**debugging aids** Computer routines—such as a *tracing routine*, *snapshot dump*, and *post mortem dump*—that are helpful in debugging programs.

**DEC** Acronym for Digital Equipment Corporation, a large manufacturer of minicomputer systems

**decatenate** To separate into two or more parts. Contrast with *concatenate*.

**deceleration time** Time required to stop a magnetic tape after reading or recording the last piece of data from a record on that tape.

**decimal** (1) Characteristic or property involving a selection, condition, or choice in which there are ten possibilities. (2) Pertaining to the

number system with a *radix* of 10. (3) *Decimal point*.

**decimal code** Form of notation by which each decimal digit is expressed separately in some other number system.

**decimal digit** Numeral in the decimal numeral system. The *radix* of the decimal system is 10, and the following symbols are used: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

**decimal number** Any number usually of more than one digit, in which the quantity represented by each digit is based on the *radix* of 10.

**decimal point** Radix point in a mixed decimal numeral, separating the fractional part from the integer part. In the decimal numeral 741.12, the decimal point is between the two 1s.

**decimal system** Base-10 positional numeration system.

**decimal-to-binary conversion** Process of converting a numeral written in base 10 to the equivalent numeral written in base 2.

$$44_{10} = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 101100_2$$

Decimal-to-binary conversion

**decimal-to-hexadecimal conversion**

Process of converting a numeral written in base 10 to the equivalent numeral written in base 16.

**decimal-to-octal conversion** Process of converting a numeral written in base 10 to the equivalent numeral written in base 8.

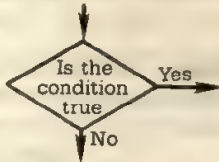
**decision** Computer operation of determining if a certain relationship exists between data in storage or registers and of taking alternative courses of action. Determination of future action.

**decision instruction** Instruction that affects the selection of a branch of a program, such as a *conditional jump instruction*.



**decision structure** Same as *selection structure*.

**decision symbol** Diamond-shaped *flow-charting symbol* used to indicate a choice or a branching in the information processing path.

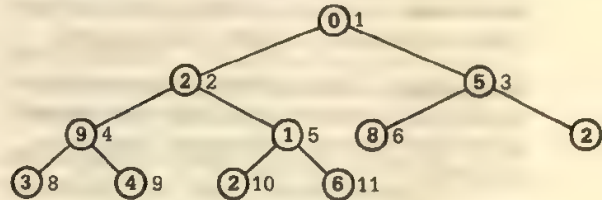


Decision symbol

**decision table** Table listing all contingencies to be considered in the description of a problem, with corresponding actions to be taken. Sometimes used instead of flowcharts to describe operations of a program. See *condition stub*, *condition entry*, *action stub*, and *action entry*.

**decision theory** Broad spectrum of concepts and techniques that have been developed both to describe and to rationalize the process of making a choice among several possible alternatives.

**decision tree** Pictorial representation of the alternatives in any situation.



Decision tree

**deck** Collection of punched cards. Synonymous with *card deck*.

**declaration statement** Part of a computer program that defines the nature of other elements of the program or reserves parts of the hardware for special use.

**decode** To translate or determine the meaning of coded information. Reverse of *encode*.

**decoder** (1) Device that decodes. (2) Matrix of switching elements that selects one or more output channels according to the combination of input signals present.

**decollate** To arrange copies of continuous

Condition/Action	Rules							
	1	2	3	4	5	6	7	8
On hand < 20	Y	Y	Y	Y	Y	Y	N	Else
Weekly usage	> 15	> 15	8-15	8-15	8-15	< 8	—	
Local vendor available	—	—	N	N	Y	—	—	
On order > 30	N	Y	N	Y	N	N	Y	
Rush order	X		X					
Regular order		X		X	X	X		
Cancel order							X	
No action								X

Decision table

## decrement

forms in sets and remove the carbon paper from them.

**decrement** Amount by which a value or variable is decreased. Contrast with *increment*.

**decryption** Process of taking an encrypted message and reconstructing from it the original meaningful message, or *plaintext*. Opposite of *encryption*.

**DECUS** Acronym for the Digital Equipment Computer (DEC) Users Society, a user group whose objective is the exchange and dissemination of ideas and information pertinent to DEC computers.

**dedicated** Pertaining to programs, machines, or procedures that are designed or reserved for special use.

**dedicated computer** Computer whose use (not necessarily design) is reserved for a particular task. Compare *special-purpose computer*.

**dedicated device** Device designed to perform only certain functions and that cannot be programmed to perform other functions.

**dedicated lines** Telephone lines leased for exclusive use by a group or individual for telecommunications. Users pay a set fee for *leased lines* rather than the per-call or per-minute charges for *switched lines*.

**dedicated system** Computer-based device with one primary function, such as word processing. Usually easier to use for its intended task than for any other. *General-purpose systems* are usually more flexible.

**dedicated word processor** System whose hardware and software are expressly designed for, and generally limited to, word processing. Would typically have special-function keys labeled with commands, such as delete word, delete sentence, or insert.

**default** Assumption made by a system or language translator when no specific choice is given by the program or the user.

**default drive** Disk drive assigned by a system when no drive number is specified by the user.

**default value** Assigned quantity for a device or program, set by the manufacturer. Usually the most common or safest answer in a program.

**deferred address** Indirect address. See *deferred entry*, *deferred exit*, and *indirect addressing*.

**deferred entry** Entry into a subroutine that occurs as a result of a *deferred exit* from the program that passed control to it.

**deferred exit** Passing of control to a subroutine at a time determined by an asynchronous event rather than at a predictable time. See *deferred entry*.

**definition of a problem** Art of compiling logic in the form of algorithms, flowcharts, and program descriptions that clearly explain and define the problem.

**degausser** Device used to erase information from magnetically recorded media (disks or tapes). Also called bulk eraser.

**degradation** Condition in which a system continues to operate but at a reduced level of service. Unavailability of proper equipment maintenance, and computer programs not maintained to accommodate current needs, are the two most common causes.

**deinstall** To remove a program or hardware device from active service.

**dejagging** Computer graphics technique for drawing smooth lines, characters, and polygons.

**delay circuit** Electronic circuit that deliberately delays the delivery of a signal for a present interval.

**delay line storage** Storage device that consists of a delay line and a means for regenerat-



ing and reinserting information into the delay line. Used in early computers.

**delete** (1) To remove or eliminate. To erase data from a field or to eliminate a record from a file. (2) Method of erasing data.

**deletion record** New record that will replace or remove an existing record of a master file.

**delimit** To fix the limits of something, such as to establish maximum and minimum limits of a specific variable.

**delimiter** Special character, often a comma or space, used to separate variable names or items in a list or to separate one string of characters from another, as in the separation of data items.

**delivery** Final step in the *program development cycle* where the program or system is given to the users for execution against actual data.

**demagnetization** Process of erasing information stored on magnetic disks or tapes. See *degausser*.

**demand paging** In virtual storage systems, the transfer of a page from external page storage to real storage at the time it is needed for execution.

**demand report** Report produced only upon request and used in strategic decision making to provide responses to unanticipated queries.

**demodulation** In data communications, the process of retrieving an original signal from a modulated carrier wave. Used in *data sets* to make communications signals compatible with computer terminal signals. Counterpart to *modulation*. See *modem*.

**demodulator** Device that receives signals transmitted over a communications link and converts them into electrical pulses, or bits, that can serve as inputs to a data processing machine. Contrast with *modulator*.

**demount** To remove a magnetic storage me-

dium from a device that reads or writes on it, such as to remove a disk pack from the disk drive.

**demultiplexer** Circuit that applies the logic state of a single input to one of several outputs. Contrast with *multiplexer*.

**dense binary code** Code in which all possible states of the binary pattern are used.

**dense list** See *sequential list*.

**density** Number of characters that can be stored in a given physical space. Measures how close together data are recorded on a magnetic medium, usually in bytes per inch. As *recording density* increases, the capacity of a storage device increases. See *double density*.

**dependency** Relationship where the execution of one job has to be completed before another can begin.

**depth queuing** Technique, such as shading, used to enhance the three-dimensional appearance of a two-dimensional object.

**deque** Double-Ended QUEUE that allows insertions and deletions at both ends of a list.

**descender** Portion of lower-case letters (g, j, p, q, and y) that extends below the baseline of other characters. Also called *kern*. Contrast with *ascender*.

g, j, p, q, y Baseline

Descenders

**descending order** Order that ranges from highest to lowest in numeric value or alphabetically. Contrast with *ascending order*.

**descriptive statistics** Numerical values representing important features of a set of quantitative information, such as the arithmetic mean, range, standard deviation, ratios, percentages, and rates of change.

**descriptor** Significant word that helps to cat-

## design aids

ategorize or index information. Sometimes called a *keyword*.

**design aids** Computer programs or hardware elements intended to assist in implementing a computer system. See *debugging aids* and *programming aids*.

**design automation** Use of computers in the design and production of circuit packages, new computers, and other electronic equipment.

**design costs** Costs associated with systems design, programming, training, conversion, testing, and documentation.

**design cycle** (1) In a hardware system, the complete cycle of development of equipment, which includes breadboarding, prototyping, testing, and production. (2) In a software system, the complete plan for producing an operational system, which includes problem description, algorithm development, flowcharting, coding, program debugging, and documentation. See *program development cycle*.

**design engineer** Person involved in the design of a hardware product, such as a disk unit or microprocessor chip.

**design heuristics** Guidelines that can be followed when dividing a larger problem or program into smaller, more manageable modules.

**design language** Programming language whose statements and syntax facilitate its use in design work.

**design phase** Process of developing an information system based upon previously established system requirements.

**design specifications** Result of an analysis of information needs of a specific system within the organization. Included are specifications for input, processing, and output.

**desk accessories** In a graphics-based system, working tools available during use with other documents.

**desk checking** Manual checking process in which representative sample data items, used for detecting errors in program logic, are traced through the program before it is executed on the computer. Same as *dry run*.

**desktop** Screen display containing documents, papers and accessories.

**desktop computer** Small computer containing a microprocessor, input and output devices, and storage, usually in one package. Complete computer system designed to fit on the top of a desk. See *home computer*, *microcomputer*, and *personal computer*.

**destination** Device or address that receives the data during a *data transfer* operation.

**destructive operation** Process of reading or writing data that erases the data that is read or that was stored previously in the receiving storage location.

**destructive read** Process of destroying the information in a location by reading the contents.

**detachable keyboard** Keyboard not built into the same case as the video display or desk unit. Connects to the system with a cable and allows greater flexibility in positioning of the keyboard display—one result of *ergonomics*.

**detail** Small section of a larger file or graphics picture.

**detail diagram** Diagram used in *HIPO* to describe the specific function performed or data items used in a module.

**detail file** File containing relatively transient information, such as records of individual transactions that occurred during a particular period of time. Synonymous with *transaction file*. Contrast with *master file*.

**detail flowchart** Diagram that depicts the processing steps required within a particular program. See *program flowchart*.

**detail printing** Operation in which a line of



printing occurs for each record read into the computer.

**detail report** Printed report in which each line usually corresponds to one input record that has been read.

**detection** Passive monitoring of an event for the purpose of discovering a problem.

**deterministic model** Mathematical model for the study of data of known fixed values and direct cause-and-effect relationships.

**development support library** Automated facility with which a programming librarian maintains program development files, including source code versions, test data sets, and narrative documentation. Contains up-to-date representations of programs and test data in both computer- and human-readable forms. The librarian maintains the library according to a set of office and computer procedures that separate clerical and bookkeeping operations from programming tasks.

**development system** Computer system with the capabilities required for efficient hardware and software application development for a given microprocessor. Typically includes a microcomputer, monitor, printer, disk storage, PROM programmer, and an in-circuit emulator.

**development time** Time used for debugging new programs or hardware.

**development tools** Hardware and software aids intended for use in developing programs and/or hardware systems.

**device** (1) Mechanical or electrical device with a specific purpose. (2) Any computer peripheral. (3) Any piece of physical equipment within or attached to a computer.

**device cluster** Group of terminals or other devices that share a communications controller.

**device code** Eight-bit code for a specific input or output device.

**device dependent** Pertaining to a program or language that must be used with a particular computer or a particular peripheral, such as a printer or modem, or it will not function. Applied to input and output.

**device flag** One-bit register that records the current status of a device.

**device independence** Ability to command input/output operations without regard to the characteristics of the I/O devices. See *symbolic I/O assignment*. Contrast with *device dependent*.

**device media control language** Language used by the database administrator to create the physical description of a database on a disk storage device.

**device name** General name for a kind of device, such as model 3840 disk unit or IBM Personal Computer.

**diagnosis** Process of isolating malfunctions in computing equipment and of detecting mistakes in programs and systems. See *debug*.

**diagnostic routine** Routine designed to locate a malfunction in the central processing unit or a peripheral device.

**diagnostics** Messages to the user, automatically printed by a computer, that pinpoint improper commands and errors in logic. Sometimes called *error messages*.

**diagram** Schematic representation of a sequence of operations or routines. See *flowchart*.

**dialect** Particular version of a computer language. Usually a minor modification of some base language like BASIC or Pascal, but because of vast differences in modifications it may be significantly different from other dialects of the same language.

**dialog** Question-and-answer session between a computer system and a human.

**dial-up** In data communications, the use of a

## dial-up line

dial or push-button telephone to initiate a station-to-station telephone call.

**dial-up line** Normal switched telephone line used as a transmission medium for data communications. Synonymous with *switched line*. Contrast with *leased line*.

**dibit** One of the following binary number arrangements: 00, 01, 10, or 11.

**dichotomizing search** See *binary search*.

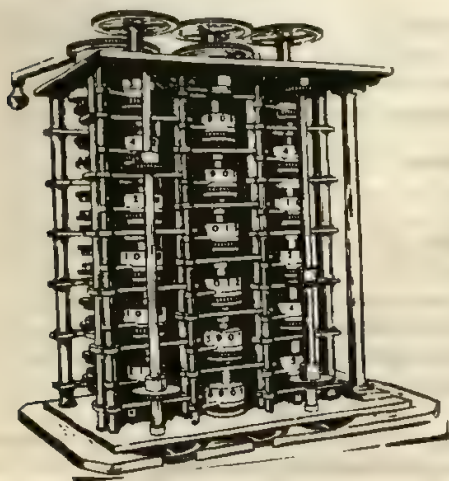
**dictionary program** Spelling-check program, often used with word processing systems. Also called *spelling checker* and proofing program.

**diddle** To tamper with data.

**die** Tiny rectangular piece of a circular wafer of semiconductor silicon, sawed or sliced during the fabrication of integrated circuits or transistors.

**difference** Amount by which one quantity or number is greater or less than another.

**difference engine** Machine designed by Charles Babbage in 1822 that mechanized a calculating function called the "method of differences." See *Babbage, Charles*.



Difference engine

**DIF** Acronym for *Data-Interchange Format*, a particular standard for data files. Used by many programs involving forecasting, it allows files created on one software package to be read by another software package—perhaps one produced by an entirely different company.

**DIF files** Files created in keeping with the DIF standard. Not interchangeable between different machines; an Apple DIF file disk cannot be read directly into an IBM machine. While the files are compatible, the disks are formatted differently for different machines.

**diffusion** High-temperature process by which impurity atoms deposited on the surface of a material, such as a silicon wafer, have sufficient thermal energy to penetrate the material, seeking to equalize their densities by displacing the host atoms and altering the electrical properties of the material in desired ways. Normal diffusion temperatures are between 900 and 1200°C for the most frequently used impurities in silicon.

**digit** One of the symbols of a numbering system used to designate a quantity. The decimal system has the ten digits 0–9.

**digital** Pertaining to representation of information by encoding as bits of 1s or 0s that indicate on or off states. Highly important in the technology of computers and data communications. Contrast with *analog*.

**digital communications** Transmissions of information by coding it into discrete on/off electronic signals.

**digital computer** Device that manipulates digital data and performs arithmetic and logic operations on such data. Contrast with *analog computer*.

**digital control** Use of digital technology to maintain conditions in operating systems as close as possible to desired values despite changes in the operating environment.

**digital data** Data represented in discrete,



discontinuous form, as contrasted with *analog data*, which is represented in continuous form.

**digital data transmission** Transmission of the original electronic signal produced by a computer device. Not all channels have digital capabilities. See *modem*.

**Digital Equipment Corporation (DEC)**  
Large manufacturer of minicomputer systems. See *PDP* and *VAX*.

**digital plotter** Output device that uses an ink pen (or pens) to draw graphs, line drawings, and other illustrations. See *plotter*.

**digital recording** Technique for recording information as discrete points onto magnetic recording media.

**digital repeater** Unit placed in a data communications path to reconstruct digital pulses, which tend to deteriorate as they travel through long conductors.

**digital signal** Two electrical states that communicate a code in binary data (1s and 0s) the computer can understand. Each 1 and 0 is a *bit*, while eight to ten bits equal a *byte*, or one character. The digital signal is converted by a *modem* into an *analog signal* (modulated) that may be transmitted over phone lines. Incoming analog signals detected by the modem are converted into digital signals (demodulated) the computer can understand.

**digital sorting** Sorting technique similar to sorting on tabulation machines. Elapsed time is directly proportional to the number of characters in the sequencing key and the value of data. Also called *radix sorting*.

**digital speech** Recorded speech broken into tiny units of sound. Each tiny unit has characteristics—such as pitch, loudness, and timbre—that can be represented by numbers, which become the digital code for speech. See *speech synthesizer*.

**digital-to-analog converter (D-A con-**

**verter)** Mechanical or electronic devices used to convert discrete digital numbers to continuous analog signals. Opposite of *analog-to-digital converter*.

**digital transmission** Transmission of data as discrete impulses.

**digitize** To transform a graphical representation (picture drawing) into a digital representation of the graphical picture. Compare *video digitizer*.

**digitizer** Input device that normally consists of a flat *tablet* that the operator traces over with a pen-like stylus or another cursor device. Patterns traced by the operator are automatically entered into the computer system's memory for subsequent processing.

**digitizing** Process of converting graphic representations, such as pictures and drawings, into digital data that can be processed by a computer system.

**digitizing tablet** Input device generally consisting of a surface underlaid by a fine grid of wires that converts graphic and pictorial data into binary inputs for use in a computer. See *digitizer*.

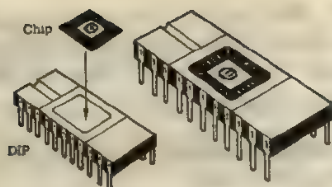
**digit place** In positional notation, the site where a digit is located in a word representing a numeral. The decimal system has the units place, the tens place, and so on.

**digit punching position** Area on a punch card reserved to represent a decimal digit, such as a punch in row 1, 2, ..., 9.

**dimension** Maximum size, or the number and arrangement of the elements, of an array.

**diode** Electronic device used to permit current flow in one direction and to inhibit current flow in the opposite direction. See *semiconductor device*.

**diode transistor logic** See *DTL*.



DIP

**DIP** Acronym for *Dual In-line Package*.

**DIP switches** Small switches found on many computers and peripherals, used to set up or adjust the equipment. See *dual in-line package*.

**direct access** Process of storing data in, or getting data from, a storage device in such a manner that surrounding data need not be scanned to locate the desired data. The time required to get desired data from the storage device is independent of the location of the data. Quicker than *sequential access*, where each record in the file is read and written in turn. Also called *parallel access* and *random access*.

**direct access processing** Same as *direct processing* and *random processing*. Contrast with *sequential processing*.

**direct access storage device (DASD)** Basic type of storage medium that allows information to be accessed by positioning the medium or accessing mechanism directly to the information required, thus permitting direct addressing of data locations. See *magnetic disk* and *magnetic drum*.

**direct address** Address that specifies the storage location of an operand. Contrast with *indirect address*.

**direct-connect modem** Modulator/demodulator that plugs directly into a modular telephone jack for use in data transmission. Contrast with *acoustic coupler* and *internal modem*.

**direct conversion** Method of converting

from one system to another by ceasing to operate the old system when the new one is implemented. Also called *crash conversion*. Contrast with *parallel conversion* and *phased conversion*.

**direct coupled transistor logic (DCTL)**

Logic system that uses only transistors as active elements. *See* *logic*.

**direct current** Flow of electrons in one direction such as supplied by a battery. Contrast with *alternating current*.

**direct data entry** Entry of data directly into the computer through machine-readable source documents or through the use of on-line terminals.

**direct distance dialing** See *DDD*.

**direct memory access (DMA)** Method by which data can be transferred between peripheral devices and internal memory without intervention by the central processing unit.

**directory** (1) In a partition by software into several distinct files, a directory is maintained on a device to locate these files. (2) Index file containing the names and locations of all the files contained on a storage medium.

**direct processing** Technique of handling data in random order, without preliminary sorting, and utilizing files on direct access storage devices. Contrast with *sequential processing*.

**disable** To remove or inhibit a normal capability. To use a command that prevents further operation of a peripheral device. Opposite of *enable*.

**disassembler** Program that takes machine-language code and generates the assembler-language code from which the machine language was produced. See *assembly language*.

**disaster dump** Computer storage dump that occurs as a result of a nonrecoverable mistake in a program.

**disaster recovery plan** Plan of action in



case a tragedy affects either hardware or software.

**disc** Alternate spelling for disk. See *magnetic disk*.

**disclaimer** Clause associated with many software products that states the vendor is not responsible for any business losses incurred due to the use of the product.

Every effort has been made to supply complete and accurate information. However, the publisher assumes no responsibility for its use, nor for any infringements of patents or other rights of third parties which would result.

#### Disclaimer

**discrete** Pertaining to distinct elements or to representation by means of distinct elements, such as characters or bits.

**discrete component** Electrical component that contains only one function, as opposed to an integrated circuit.

**disk** Magnetic device for storing information and programs accessible by a computer. Can be either a rigid *platter* (*hard disk*) or a sheet of flexible plastic (*floppy disk*). Disks have tracks where data is stored.

**disk access time** Time required to locate a specific track on a disk. Also called *seek time*. Part of total *access time*.

**disk buffer** Area of a computer's memory set aside to hold information not yet written to disk.

**disk controller card** Peripheral circuit card that connects disk drives to a computer and controls their operation.

**disk copying** Process of transferring the entire contents of one disk to another disk. Same as *disk duplication*.

**disk crash** Condition of a disk unit that makes it unusable. Usually caused by contact

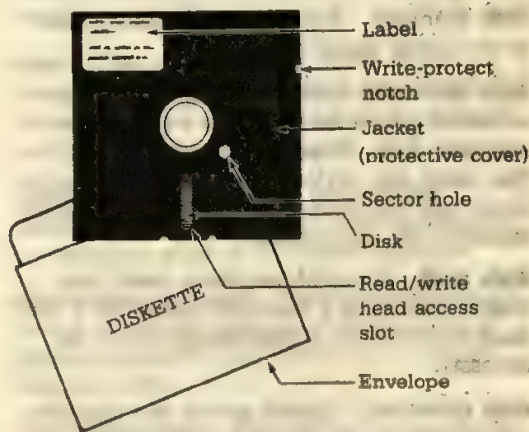
between the read/write head of the disk drive and the surface of the disk. Also called *head crash*.

**disk drive** Device that reads data from a *magnetic disk* and copies it into the computer's memory so it can be used by the computer, and that writes data from the computer's memory onto a disk so it can be stored.

**disk duplication** Process of copying information recorded on one magnetic disk onto another disk. Same as *disk copying*.

**disk envelope** Removable protective paper sleeve used when handling or storing a diskette. Must be removed before inserting the diskette in a disk drive. Compare with *disk jacket*.

**diskette** Low-cost bulk-storage medium for microcomputers and minicomputers. See *floppy disk*.



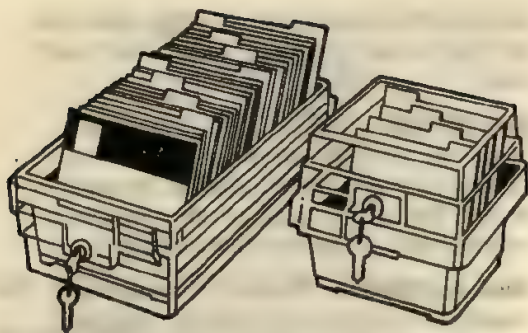
Diskette

**diskette tray** Container used to store floppy disks. May be open or closed. (See page 92.)

**disk file** File that resides on a magnetic disk. Organized collection of data stored on a disk.

**disk jacket** Permanent protective covering for a disk, usually made of paper or plastic.

## disc library



Diskette tray

The disk is never removed from the jacket, even when inserted in a disk drive. Compare with *disk envelope*.

**disk library** Special room that houses a file of disk packs under secure, environmentally controlled conditions or a storage facility that houses a file of diskettes. See *data protection* and *tape library*.

**disk memory** Storage using rotating disks as its storage element.

**disk operating system (DOS)** Operating system in which the programs are stored on magnetic disks. Typically, it keeps track of files, saves and retrieves files, allocates storage space, and manages other control functions associated with disk storage.

**disk pack** Group of removable tiered hard disks mounted on a shaft and treated as a unit. Must be placed on a disk storage unit to be accessed.

**disk partition** Logical portion of a disk that provides an organization allowing smaller blocks of data to be handled more conveniently.

**disk sector** Corresponds to a block of data storage area between two successive radials on the disk. The cutting of a disk into sectors is analogous to the way a pie would be sliced.

**disk unit** See *magnetic disk unit*.

**disk unit enclosure** Cabinet designed to

hold one or more disk drives and a power supply.

**dispatch** To select the next task and get it ready for processing.

**dispatching priority** Numbers assigned to tasks and used to determine precedence for use by the central processing unit in a multitask situation.

**dispersed data processing** Same as *distributed data processing*.

**dispersed intelligence** Network system in which the computing power is scattered or dispersed throughout the computer network.

**displacement** Difference between the base address and the actual machine-language address

**display** (1) Physical representation of data, as on a screen or display. (2) Lights or indicators on computer consoles. (3) Process of creating a visual representative of graphic data on an output device.

**display adapter** Adapter board that electronically links the computer to a display screen and determines its capabilities, such as degree of resolution, color vs. monochrome, and graphics vs. no graphics.

**display background** That part of displayed graphic data that is not part of the image being processed and is not subject to change by the user. Used to highlight the image part of the display, called the *display foreground*.

**display console** Input/output device consisting of a display screen and an input keyboard. Sometimes called a *workstation*.

**display cycle** Time it takes a visual display screen to be completely refreshed. See *refresh display cycle*.

**display device** Device capable of producing a visual representation of data, such as a *graphics printer*, *digital plotter*, and *video display terminal*.

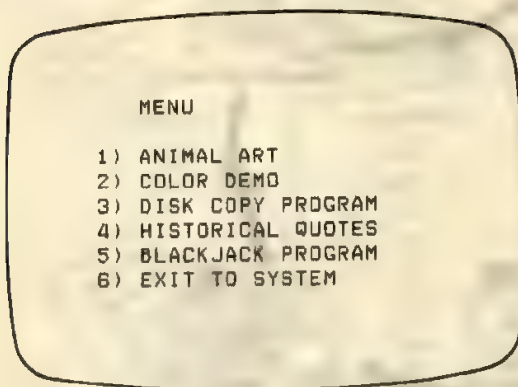


**display foreground** That part of graphic data being displayed on a visual display device that is subject to alteration by the user. Contrast with *display background*.

**display highlighting** Ways of emphasizing information on a display screen by using such enhancers as blinking, boldface, high contrast, reverse video, underlining, or different colors. See *highlighting*.

**display image** That portion of a displayed graphics file that is currently visible on the display device.

**display menu** Onscreen series of program options that allows the user to choose the next function or course of action to be executed, such as to print the contents of the visual display or to save a graphic display on a disk.



Display menu

**display surface** Medium upon which a visual representation of graphic data is made, such as a visual display screen, printer paper, plotter paper, or film.

**display terminal** Any output device capable of producing a visual representation of graphic data. See *display device*.

**display tolerance** Measure of accuracy with which graphic data can be output.

**display type** Technology of the display, such

as cathode ray tube (CRT), light-emitting diode (LED), and liquid crystal display (LCD)

**display unit** Device that provides a visual representation of data. See *cathode ray tube*, *line printer*, *plasma display*, and *plotter*.

**distortion** Any undesired change in the waveform of an electric signal passing through a circuit, including the transmission medium. In the design of any electronic circuit, one important problem is to modify the input signal in the required way without producing distortion beyond an acceptable degree.

**distributed database** Database spread throughout the computer systems of a network.

**distributed data processing** Concept of performing operations in a computer system whose terminals and central processing unit are separated geographically but are linked together functionally in a communications network. Contrast with *centralized data processing*. (See page 94.)

**distributed design** Information structure that identifies the existence of independent operating units but recognizes the benefits of central coordination and control.

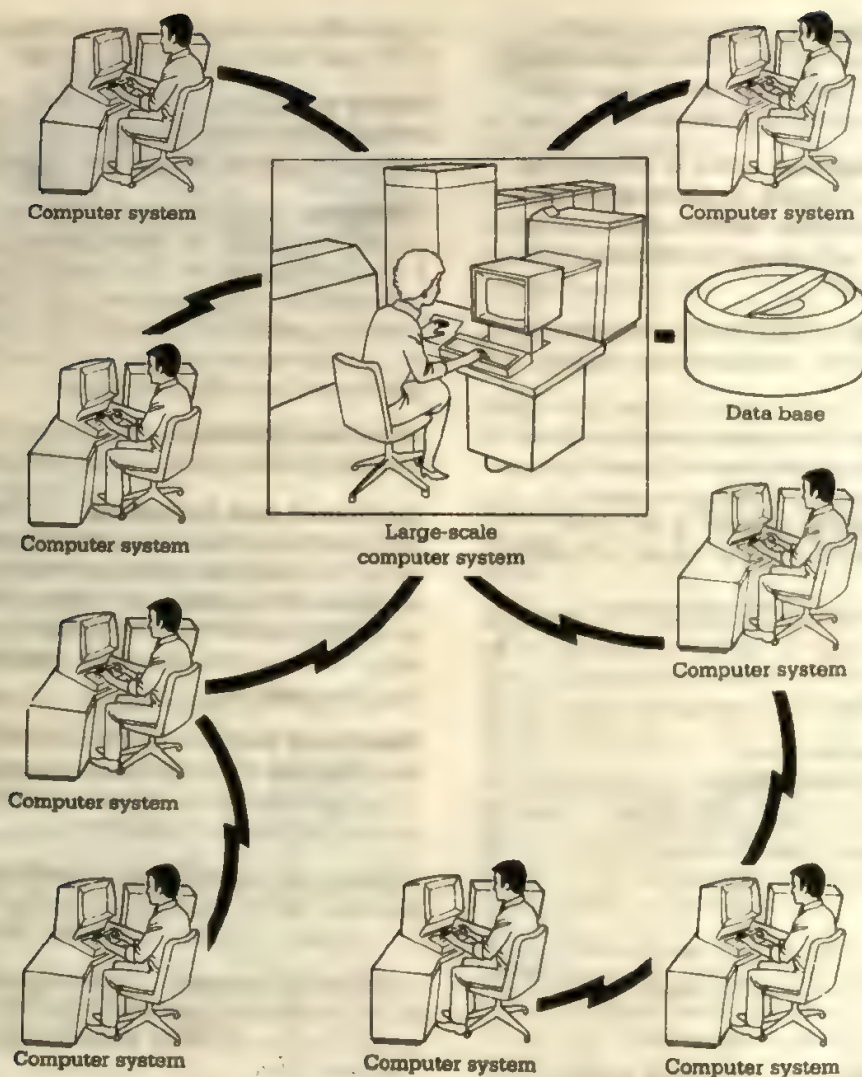
**distributed information processing system** Set of interacting computer systems or databases situated in different locations.

**distributed network** Network configuration in which all node pairs are connected either directly or by redundant paths through intermediate nodes.

**distributive sort** Sort formed by separating the list into parts and then rearranging the parts in order.

**disturbance** Any irregular phenomenon that interferes with the interchange of intelligence during transmission of a signal. See *noise*.

**dithering** (1) Intermingling of dots of various colors to produce what appears to be a new color. The dots must be so small and closely



Distributed data processing

spaced that the eye fuses them together. (2) Computer graphics technique for increasing the intensity of the display when the image and device resolutions coincide.

**division check** Multiplication check in which a zero-balancing result is compared against the original dividend.

**DMA** Acronym for *Direct Memory Access*.

**DML** Acronym for *Data Manipulation Language*.

**DNC** Acronym for *Direct Numerical Control*, a method of computer control of automatic machine tools whereby control is applied at discrete points in the process rather than applied continuously. See *APT* and *numerical control*.

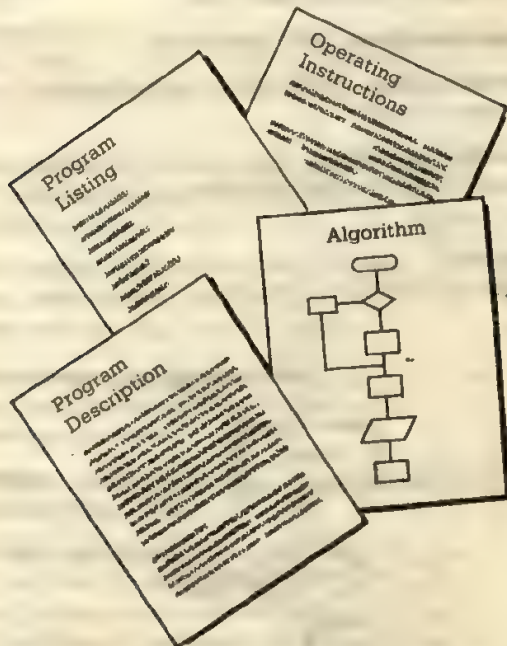
**DOA** Acronym for *Dead On Arrival*. Used to



describe a product that does not work when received from the manufacturer or supplier.

**document** (1) Handwritten, typewritten, or printed sheet or sheets of paper containing data. (2) Any representation or collection of information or text, whether human-readable or machine-readable.

**documentation** (1) During systems analysis and subsequent programming, the preparation of documents that describe such things as the system, the programs prepared, and the changes made at later dates. See *program development cycle*. (2) *Internal documentation* in the form of *comments* or *remarks*.



Documentation

**documentation aids** Aids that help automate the documentation process, such as program description write-ups, flowcharts, HIPO, program runs, and pseudocode.

**documentor** Program designed to use data processing methods in the production and maintenance of program flowcharts, text mate-

rial, and other types of tabular or graphic information.

**document reader** Any OCR or OMR equipment that reads a limited amount of information. See *optical character* and *optical mark reader*.

**document retrieval** Process of acquiring data from storage devices and, possibly, manipulating the data and subsequently preparing a report.

**domain** (1) Set of data values from which a relational attribute may draw its values. (2) Any problem area of interest.

**domain knowledge** Knowledge of the application environment.

**domain tip** Type of storage device that uses thin films to create magnetic domains for storing digital data. See *thin film*.

**dopant** Any substance added in the *doping* process, such as arsenic or phosphorus. See *semiconductor device*.

**dope vector** Vector wherein an atom of a linked list describes the contents of the other atoms in the list.

**doping** Process of introducing impurity elements into the crystalline structure of pure silicon during semiconductor fabrication. See *semiconductor device*.

**DOS** Acronym for *Disk Operating System*, a specialized, disk-oriented program that provides an easy-to-use link between the user and a computer's disk drive.

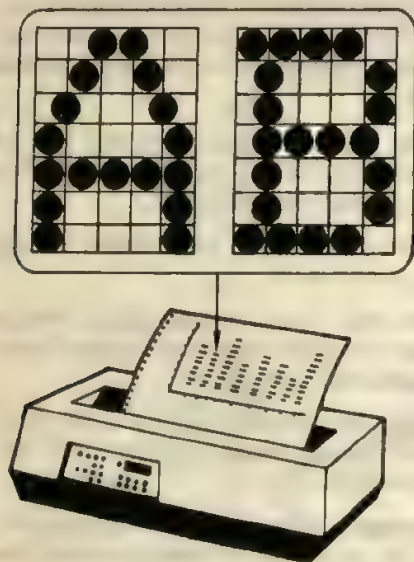
**dot commands** Approach to formatting in which a word processor records formatting instructions in the text but does not apply them to the text until it is printed.

**dot matrix** Technique for representing characters by composing them out of selected dots from within a rectangular matrix of dots.

**dot matrix printer** Printer that creates text characters and graphs with a series of closely

## dot pitch

spaced dots. Uses tiny hammers to strike a needle mechanism against the paper at precise moments as the print head moves across the page. Some produce dot patterns fine enough to approach the print quality of a *daisy wheel printer*.



Dot matrix printer

**dot pitch** Distance in millimeters between individual dots on a monitor screen. The smaller the dot pitch, the more potential dots to be displayed, giving better resolution.

**double buffering** Software or hardware technique to transfer information between the computer and peripheral devices. Information in one buffer is acted on by the computer while information in the other is transferred in or out.

**double-click** Method to invoke a command by using the *mouse* button. The pointer or cursor is placed in the correct position on a display screen and the mouse button is pressed twice in rapid succession.

**double-dabble** Process of converting binary numbers into their decimal equivalents.

**double density** Having twice the storage capacity of a normal disk or tape. Ability to store twice as much data in a given area on a disk or tape as *single density*. Compare *quad-density*.

**double precision** Pertaining to the use of two computer words to represent a number to gain increased *precision*. Contrast with *single precision* and *triple precision*.

**double punch** More than one numeric punch in any one column of a card.

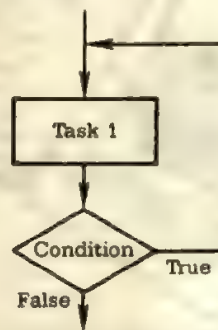
**double-sided disk** Magnetic disk capable of storing information on both of its surfaces. Contrast with *single-sided disk*.

**doublestriking** See *overstriking*.

**double word** Entity of storage that is two words in length.

**doubly linked list** List in which each atom contains one pointer that relates to the successor atom.

**do until** One of the variations of the primitive loop construct of structured programming.

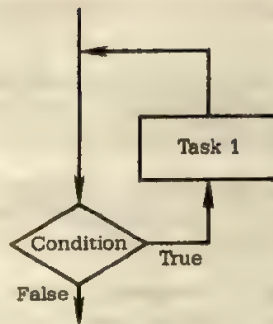


Do until

**do while** Variation of the primitive loop construct of structured programming.

**down** Condition that exists when the hardware circuits of a computer are inoperable or there is a failure in the software system. When





Do while

a computer is down, it is simply not functioning.

**down-line processor** Processor at or near the terminal point in a data communications network that facilitates the transmission of data.

**download** Process of transferring data from a large central computer system to a smaller, remote computer system. Opposite of *upload*.

**downtime** Length of time a computer system is inoperative due to a malfunction. Contrast with *available time* and *uptime*.

**downward compatible** Pertaining to a computer compatible with a smaller or previous-generation computer.

**DPMA** Acronym for *Data Processing Management Association*.

**DPMA certificate** Certificate formerly given by the Data Processing Management Association indicating that a person has attained a certain level of competence in the field of data processing. This *Certificate in Data Processing* is obtained by passing an examination offered yearly and now administered by the *Institute for Certification of Computer Professionals*.

**draft mode** Low-quality printing mode available on some printers. See *draft quality*.

**draft quality** Measure of quality for printed output. Usually refers to the result of top-speed

printing and therefore not the most precisely defined or fully filled-in characters. Considered acceptable for working copies but not final work. Contrast with *letter quality*.

**drag** Action of moving the *mouse* while holding the button down; used to move or manipulate objects on a computer's display screen.

**dragging** Technique of making a displayed graphics object follow the cursor. Accomplished in some systems by moving the *mouse* while holding down the mouse button.

**drain** One of three connecting terminals of a field effect transistor, the other two being the *source* and the *gate*. If the charge carriers are positive, conventional current flows from source to drain.

**DRAM** Acronym for *Dynamic RAM*.

**drawing** Process of creating graphical illustrations with a computer's graphic capabilities, such as creating lines with a computer graphics system or producing a detailed sketch with a drawing and painting program.

**drift** Change in the output of an electric circuit. Occurs slowly over a period of time.

**drive** Physical components necessary for writing data to, and reading data from, a diskette or disk. Short name for *disk drive*.

**drive number** Numeric value specifying one of the disk drives available in a system.

**driver** Series of instructions the computer follows to reformat data for transfer to and from a particular peripheral device. Electrical and mechanical requirements differ from one kind of device to another, and software drivers are used to standardize the format of data between them and the central processor.

**DRO** Acronym for *Destructive Read Out*. See *destructive read*.

**droid** Humanlike robot, contraction of *android* (male) or *gynoid* (female).

**drop** (1) In a network, a remote terminal loca-

## drop dead halt

tion. (2) Distance between top and bottom of a sheet of computer stationery, measured in millimeters or inches.

**drop dead halt** Halt from which there is no recovery. Same as *dead halt*.

**drop in** Character that appears erroneously—on a display screen, on a printout, or in a file—because the disk drive or tape drive misstored or misread one or more bits. Opposite of *drop out*.

**drop out** (1) In data transmission, a momentary loss in signal, usually due to the effect of noise or system malfunction. (2) Character that vanishes from a display, printout, or file because the disk drive or tape drive misstored or misread one or more bits. Opposite of *drop in*.

**drum** See *magnetic drum*.

**drum plotter** Output device that draws schematics, graphs, pictures, and so forth on paper with automatically controlled pens. The paper is wrapped around a cylindrical drum that turns forward and backward at various speeds under one or more pens that slide to and fro, marking the paper. Contrast with *flatbed plotter*.

**drum printer** Printing device that uses a drum embossed with alphanumeric characters. Type of *line printer*, that can print several thousand lines per minute.

**drum sorting** Sort program that uses magnetic drums for auxiliary storage during sorting.

**drum storage** See *magnetic drum*.

**dry plasma etching** Method for developing a mask on a wafer.

**dry run** Program-checking technique of examining the logic and coding of a program from an algorithm and written instructions and recording the results of each step of the operation before running the program on the computer. Same as *desk checking*.

**DSL** Acronym for *Dynamic Simulation Language*.

**DTL** Acronym for Diode Transistor Logic, microelectronic logic based on connections between semiconductor diodes and the transistor

**dual channel controller** Controller that enables reading from, and writing to, a device to occur simultaneously

**dual density** (1) Pertaining to tapes or disks on which data is densely recorded. (2) Floppy disk with double-sided recording capability.

**dual disk drive** Floppy disk system that contains two disk drives, providing an increased storage capacity.

**dual in-line package (DIP)** Popular type of integrated circuit package on which a chip is mounted. Provides a protective casing for the integrated circuit and pin connections for plugging the chip into a circuit board.

**dual intensity** Ability of a terminal or printer to produce characters in regular as well as highlighted or bold formats. See *overstriking*.

**dual processors** (1) Two central processing units within a computer system that can function simultaneously. (2) Two microprocessors in a single microcomputer which allow the use of software designed for either chip.

**dual-sided disk drives** Disk drives that use two read/write heads to store and retrieve data on both the top and bottom sides of a disk.

**dumb terminal** Video display terminal with minimal I/O capabilities and no processing capability. Contrast with *intelligent terminal* and *smart terminal*.

**dummy** Pertaining to an artificial argument, instruction, address, or record of data inserted solely to fulfill prescribed conditions.

**dummy argument** Variables, used as function arguments, that do not have any values.

**dummy instruction** (1) Artificial instruction



or address inserted in a list to serve a purpose other than its execution as an instruction. (2) Instruction in a routine that, in itself, does not perform any functions. Often used to provide a point at which to terminate a program loop.

**dummy module** Skeleton of module with entry and exit, but no actual processing. Particularly useful in top-down testing when subordinate subfunctions are not ready for integration.

**dump** Data that results from a *dumping* process. Duplication of the contents of a storage device to another storage device or to a printer.

**dumping** Copying all or part of the contents of a storage unit, usually from the computer's internal storage, into an auxiliary storage unit or onto a line printer. See *storage dump*, *post mortem dump*, and *snapshot dump*.

**duplex** Pertaining to a communications system or equipment capable of transmission in both directions. See *full-duplex* and *half-duplex*.

**duplex channel** Communications channel that allows simultaneous transmission in both directions. See *full-duplex*, *half-duplex*, and *simplex*.

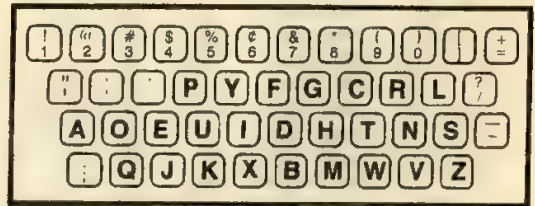
**duplexing** Use of duplicate computers, peripheral equipment, or circuitry so that, in the event of a component failure, an alternate component can enable the system to continue.

**duplicate** To copy so that the result remains in the same physical form as the source, such as to make a new diskette with the same information and in the same format as an original diskette. Contrast with *copy*.

**duplication check** Check requiring that the results of two independent performances of the same operation be identical. May be made concurrently on duplicate equipment or at different times on the same equipment.

**dust cover** Plastic dust covers used to protect microcomputers, disk units, terminals, printers, and so on from one of their worst enemies.

**Dvorak keyboard** Keyboard arrangement designed by August Dvorak. Provides increased speed and comfort and reduces the rate of errors by placing the most frequently used letters in the center for use by the strongest fingers. In this fashion, finger motions and awkward strokes are reduced by over 90 percent in comparison with the familiar *QWERTY* keyboard. The Dvorak system, although patented in 1936, did not really become popular until its approval by ANSI in 1982. Today, some businesses are requiring their keyboarding personnel to use this system. Also, several computer companies are now manufacturing keyboards with a switch that will change from one keyboard to the other. The Dvorak keyboard puts the five vowel keys, AOEU, together under the left hand in the center row, and the five most frequently used consonants, DHTNS, under the fingers of the right hand. Compare *Maltron keyboard*; *QWERTY keyboard*.



Dvorak keyboard

**dyadic** Pertaining to an operation that uses two operands.

**dyadic operation** Any operation on two operands.

**dynamic** Pertaining to circuitry that stores information as charges on MOS capacitors. Usually volatile, it requires periodic *refreshing*.

**dynamic address translation (DAT)** In virtual storage systems, the change of a *virtual*

## **dynamic dump**

*storage* address to a *real storage* address during execution of an instruction.

**dynamic dump** Dump taken during the execution of a program. See *snapshot dump*. Contrast with *post mortem dump* and *static dump*.

**dynamic RAM** Storage that the computer must refresh at frequent intervals. Contrast with *static RAM*.

**dynamic relocation** Movement of part or all of an active (currently operating) program from one region of storage to another. All necessary address references are adjusted to enable proper execution of the program to continue in its new location.

**dynamic scheduling** Job scheduling determined by the computer on a moment-to-

moment basis, depending upon the circumstances.

## **Dynamic Simulation Language (DSL)**

High-level programming language, suited primarily for simulation of engineering and scientific problems of a continuous nature. Because DSL facilitates the solution of ordinary differential equations that frequently are functions of time, it is particularly useful for transient analysis of dynamic systems.

**dynamic storage** Any memory device that must constantly be recharged or refreshed at frequent intervals to avoid loss of data. Very *volatile storage*.

**dynamic storage allocation** Automatic *storage allocation*.





**E** In floating-point numbers, a symbol that stands for *exponent*. 17E2 means "17 to the power 2." See *E notation*.

**EAM** Acronym for *Electronic Accounting Machine*. Usually refers to unit record equipment. See *unit record system*.

**EAROM** Acronym for Electrically Alterable ROM. ROM memory that can be selectively altered without erasing all stored data, as is done with *EPROM* devices.

**easywriter** One of many software packages used for word processing.

**eavesdropping** Passive wiretapping, interception of messages, usually without detection.

**EBAM** Acronym for Electron Beam Addressed Memory, an electronic storage device that uses electrical circuits to control a beam that reads from or writes on a metal oxide semiconductor surface.

**EBCDIC** Acronym for Extended Binary Coded Decimal Interchange Code, an 8-bit code used to represent data in modern computers. EBCDIC can represent up to 256 distinct characters and is the principal code used in many of the current computers. Compare *ASCII*.

**echo** (1) In data communications, the return of a transmitted signal to its source, with a delay that indicates the signal is a reflection rather than the original. (2) In computer graphics, to provide visual feedback to the designer during graphic input to the system.

Character	EBCDIC
0	1111 0000
1	1111 0001
2	1111 0010
3	1111 0011
4	1111 0100
5	1111 0101
6	1111 0110
7	1111 0111
8	1111 1000
9	1111 1001
A	1100 0001
B	1100 0010
C	1100 0011
D	1100 0100
E	1100 0101
F	1100 0110
G	1100 0111
H	1100 1000
I	1100 1001
J	1101 0001
K	1101 0010
L	1101 0011
M	1101 0100
N	1101 0101
O	1101 0110
P	1101 0111
Q	1101 1000
R	1101 1001
S	1110 0010
T	1110 0011
U	1110 0100
V	1110 0101
W	1110 0110
X	1110 0111
Y	1110 1000
Z	1110 1001

EBCDIC

## echo check

**echo check** Check on the accuracy of a data transfer operation in which the data received is transmitted back to the source and compared with the original data.

**Eckert, J. Presper** Coinventor of *ENIAC*. Collaborated with John Mauchly at the Moore School of Electrical Engineering, University of Pennsylvania, on developing the Electric Numerical Integrator And Computer for Army Ordnance between 1943 and 1946. This was the first large-scale, all-electronic digital computer. Its development launched the computer industry as we know it today. See *ENIAC* and *Mauchly, John*.

**ECL** Acronym for *Emitter-Coupled Logic*, also called *current mode logic*. Faster than TTL, but much less popular.

**ECOM** Acronym for Electronic Computer Oriented Mail, a process of sending and receiving messages in digital form over telecommunications facilities.

**edge** (1) In computer graphics, the straight line segment which is the intersection of two planes' faces of a solid, such as the edges of a

cube. (2) Connection between two nodes in a graph. See *indegree*.

**edge card** Circuit board (or card) with contact strips along one edge, designed to mate with an edge connector.

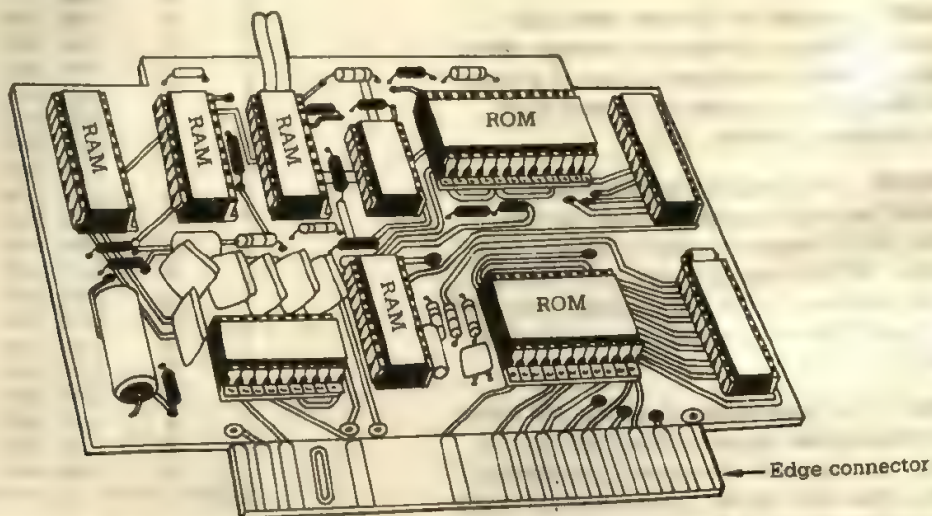
**edge connector** Slot-shaped electrical socket that connects a circuit card to a motherboard or chassis.

**edge cutter/trimmer** Device for removing the sprocketed margin from continuous-form printer paper

**edge-punched card** Card into which data may be recorded by punching holes along one edge in a pattern similar to that used for punched tape. Hole positions are arranged to form coded patterns in five, six, seven, or eight channels and usually represent data in a binary coded decimal system.

**edge sharpening** Process of sharpening the edges of a digitized picture.

**edit** (1) To check the correctness of data. (2) To change as necessary the form of data by adding or deleting certain characters. Part of a



Edge connector



program can edit data for printing, adding special symbols, spacing, deleting, nonsignificant zeros, and so on.

**editing** Making the corrections or changes in a program or data. See *data editing*.

**editing run** In batch processing, the editing program will check the data for ostensible validity—such as testing to ensure that dates and numbers fall within the expected ranges, comparing totals with separately entered batch or hash totals, and proving check digits—and identify any errors for correction and resubmission.

**edit line** "Status report" line displayed on the screen when certain spreadsheet or word processing programs are in use. Tells the user the present location of the cursor, the amount of memory left, and (in some word processing programs) the name of the file in use. In spreadsheets, it will also show the contents or formula of the cell at the cursor location, and one or two more items of information (depending on which spreadsheet is being used).

**edit mode** Available in many programs, permits easy modification of cell contents without rekeying the entire entry.

**editor** Computer program designed to make it easy to review and alter a file or program interactively. One editing command might locate and display the first occurrence of a given string of characters; a second command might delete or change those characters wherever they occur.

**EDP** Acronym for *Electronic Data Processing*.

**EDS** Acronym for Exchangeable Disk Store.

**EDSAC** Acronym for Electronic Delayed Storage Automatic Computer, the first digital computer to feature the stored-program concept. Developed at Cambridge University in Great Britain in 1949. See *Wilkes, Maurice Vincent*.

**EDVAC** Acronym for Electronic Discrete Variable Automatic Computer, the first U.S.-built

computer that featured a stored-program unit. Developed at the Moore School of Electrical Engineering, University of Pennsylvania, in 1951, by Dr. John von Neumann. See *von Neumann, John*.

**EEROM** Storage device that can be erased electrically and reprogrammed.

**effective address** Address derived by performing any specified address modification operations upon a specified address.

**effectiveness** Degree to which the output produced achieves the desired purpose.

**EFT** Acronym for *Electronic Funds Transfer*. An EFT network transfers funds from one account to another with electronic equipment rather than with paper media, such as checks. Increasingly popular method of paying periodic bills.

**egoless programming** Concept of arranging the programming tasks so that credit for success or blame for failure must be shared by several programmers rather than just one person. Uses *structured walkthroughs* and other techniques.

**EIA** Acronym for Electronic Industries Association.

**EIA interface** Standard interface between peripherals and microcomputers, and modems and terminals. Another name for *RS-232C* interface.

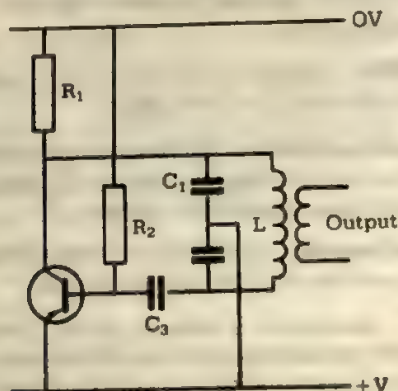
**eight-bit chip** CPU chip that processes data eight bits at a time. Contrast with *sixteen-bit chip* and *thirty-two-bit chip*.

**electrical communications** Science and technology by which information is collected from an originating source, transformed into electric currents or fields, transmitted over electrical networks or through space to another point, and reconverted into a form suitable for interpretation by a receiving entity.

**electrical schematic** Diagram of the logical arrangement of hardware in an electrical circuit

## electromagnetic delay line

or system, using conventional symbols. Can be constructed interactively by computer-aided design.



Electrical schematic

**electromagnetic delay line** Delay line whose operation is based on the time of propagation of electromagnetic waves through distributed or lumped capacitance and inductance. Used in early computers.

**electromechanical** Pertaining to any system or device for processing data that uses both electrical and mechanical principles.

**electron beam deflection system** Narrow stream of electrons moving in the same direction under the influence of an electric or magnetic field. See *gun* and *yoke*.

**electronic** Pertaining to the flow of electricity through semiconductors, valves, and filters, in contrast with the free flow of current through simple conductors. The essence of computer technology is the selective use and combination of electronic apparatus whereby current can be allowed to flow or can be halted by electronic switches working at a very high speed.

### electronic accounting machine (EAM)

Data processing equipment that is predominantly electromechanical, such as a *keypunch*, mechanical sorter, tabulator, or *collator*.

**electronically programmable** Pertaining to Programmable ROM or any other digital device in which the data 1s and 0s in binary code can be entered electronically, usually by the user with a piece of equipment called a *PROM Programmer*.

**electronic bulletin board** Computer system that maintains a list of messages so people can call up (with their computer systems) and either post a message or read those already there.

**electronic cottage** Concept of permitting workers to remain at home to perform work, using computer terminals connected to a central office.

**electronic data processing (EDP)** Data processing performed largely by electronic equipment, especially electronic digital computers.

### electronic data processing system

System for data processing by means of machines using electronic circuitry at electronic speed, as opposed to electromechanical equipment.

**electronic filing** How computer systems store information electronically on disks or tapes.

**electronic funds transfer (EFT)** Cashless method of paying for goods or services. Electronic signals between computers are used to adjust the accounts of the parties involved in a transaction. Commonly used to make periodic payments, such as insurance premiums. Increasingly available as an option for "depositing paychecks." See *EFT*.

### Electronic Industries Association (EIA)

Association of electronic manufacturers and others who set standards, disseminate information, provide industry-government liaison, and maintain public relations for the industry.

**electronic journal** Log file summarizing, in chronological sequence, the processing activities performed by a system.



**electronic magazine** (1) Magazine published in a videotape or videodisk format. (2) Type of *electronic publishing*.

**electronic mail** Process of sending, receiving, storing, and forwarding messages in digital form over telecommunication facilities. Also called *E-mail*.

**electronic music** Music in which the sounds are produced by electronic means. See *computer music* and *synthesizer*.

**electronic office** Office that relies on word processing and computer and data communications technologies. See *automated office*.

**electronic pen** Pen-like stylus commonly used in conjunction with a cathode ray tube for inputting or changing information under program control. Often called *light pen*.

**electronic power supply** Source of electrical energy employed to furnish the tubes and semiconductor devices of an electronic circuit with the proper electric voltages and currents for their operation.

**electronic publishing** Technology

comprising a variety of activities that contain or convey information with a high editorial and value-added content in a form other than print. Includes educational software disks, educational software cassettes, online databases, electronic mail videotext, teletext, videotape cassettes, and videodisks. See *comic book* and *electronic magazine*.

**electronics** Branch of science and technology relating to the conduction and control of electricity flowing through semiconducting materials or through vacuum or gases.

**electronic spreadsheet** Computer program that turns a computer terminal into a huge ledger sheet. Allows large columns and rows of numbers to change according to parameters determined by the user. A whole range of numbers can be changed when a single entry is varied, allowing complex projections and numerical forecasts to be performed without tedious manual calculations. See *VisiCalc*.

**electron tube** Dominant electronic element found in computers prior to the advent of the transistor. See *first generation computers* and *vacuum tube*.

DEPRECIATION TABLE

Description	:	Computer	
Original Cost	\$	10000.00	Dollars
Salvage Value	\$	2000.00	Dollars
Length of Term		7	Years
Rate of Depreciation		200.00	Per Cent

Schedule of Remaining Value

Year	Current Value	Amount of Depreciation	Value Remaining
1	10000.00	2857.14	7142.86
2	7142.86	2040.82	5102.04
3	5102.04	1457.73	3644.31
4	3644.31	1041.23	2603.08
5	2603.08	603.08	2000.00
6	2000.00	0.00	2000.00
7	2000.00	0.00	2000.00
Average Amount of Depreciation			\$ 1142.86

Electronic spreadsheet

electrosensitive paper

**electrosensitive paper** Printer paper with a thin coating of conductive material, such as aluminum. Print becomes visible because it darkens where a matrix-type print head allows electric current to flow onto the conductive surface.

**electrosensitive printer** *Nonimpact printer* that uses electricity to form characters on specially treated paper.

**electrostatic plotter** Output device that draws graphic data on paper by using static electrical energy. Generally faster than a *pen plotter*.

**electrostatic printer** High-speed nonimpact printer that forms characters on chemically treated paper. See *xerographic printer*.

**electrothermal printer** High-speed printer that uses heated elements to create characters as matrices of small dots on heat-sensitive paper.

**element** Item of data within an *array* or a *matrix*.

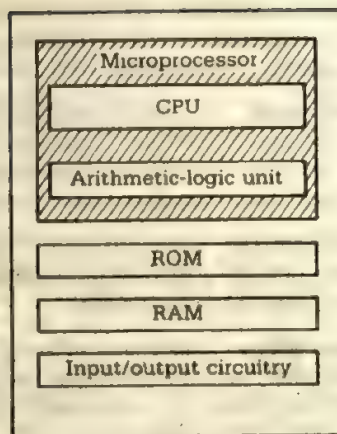
**elementary diagram** Wiring diagram of an electrical system in which all devices are drawn between vertical lines that represent power sources. Contains logic elements, components, wire nets, and text. Can be constructed interactively on a CAD system.

**elements of a microcomputer** Components of a microcomputer, including a microprocessor for the central processing unit, program memory (usually ROM), program and data storage (usually RAM), input/output circuitry, and clock generators.

**eleven-punch** Punch in the second row from the top of a Hollerith punched card. Synonymous with *X-punch*.

**elite type** Size of type that fits twelve characters into each inch of type. Contrast with *pica*.

**ELIZA** Early natural-language-understanding program that simulated a psychotherapist.



Elements of a microcomputer

**ellipse** Geometrical figure like a flattened circle. Ellipse creation is an automatic function of virtually all computer graphics systems.

**E-mail** Abbreviation for *electronic mail*, a communications service for computer users wherein textual messages are sent to a central computer system, or electronic "mailbox," and later retrieved by the addressee.

**embedded command** In word processing, one or more characters inserted into the text that do not print but direct the word processing program or printer to perform some task, such as end a page or skip a line.

**embedded systems** Computer systems that cannot be programmed by the user because they are preprogrammed for a specific task and are buried within the equipment they serve.

**embedding** Placing special printer commands within the text as instructions. See *embedded command*.

**emitter** Electrode within a junction *transistor*. See *base* and *collector*.

**empty string** String containing no characters. Also called null string.

**emulate** (1) To imitate one hardware system with another, by means of an electronic attachment, such that the imitating system accepts the same data, executes the same programs,



and achieves the same results as the imitated system. (2) To have a program simulate the function of another software or hardware product.

**emulator** Type of program or device that allows user programs written for one kind of computer system to be run on another system.

**emulsion laser storage** See *laser storage*.

**enable** To switch a computer device or facility so it can operate. Opposite of *disable*.

**encipher** To alter data (scramble) so it is not readily usable unless the changes are first undone. See *encryption*.

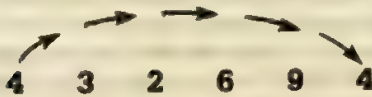
**enclosure** Housing for any electrical or electronic device.

**encode** To convert data into a code form acceptable to some piece of computer equipment. Opposite of *decode*.

**encoder** Device that produces machine-readable output, such as paper tape; either from manual keyboard depressions or from data already recorded in some other code.

**encryption** Coding data in such a way as to make it unintelligible without the key to *decryption*.

**end-around carry** Carry from the most-significant-digit place to the least-significant-digit place.

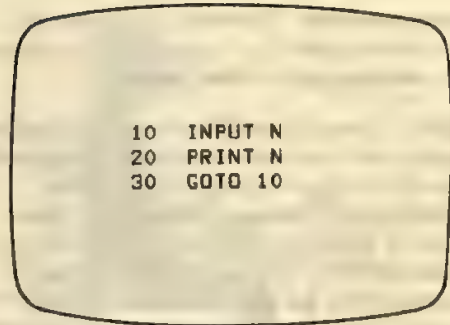


End-around-carry

**end-around shift** See *circular shift*.

**endless loop** Endless repetition of a series of instructions with no exit from the loop possible. Same as *infinite loop*.

**end mark** Code or signal that indicates termination of a unit of data. See *stop bit* and *group mark*.



Endless loop

**end-of-block (EOB)** Termination of a block.

**end-of-file (EOF)** Termination or point of completion of a quantity of data. End-of-file marks are used to indicate this point on magnetic files. See *end-of-tape marker*.

**end-of-job** Condition that alerts the program that a job is done and starts another action.

**end-of-message (EOM)** Termination of a message.

**end-of-page halt** Feature that stops the printer at the end of each completed page of output.

**end-of-tape marker** Marker on a magnetic tape used to indicate the end of the permissible recording area.

**end-of-text** Transmission control character used to indicate to receiving hardware that the previous character was the last character of message text.

**end-of-transmission** Control character used to indicate that a transmission has been completed.

**end user** Anyone who uses a computer system or its output.

**engine** Another name for a processor.

**engineering units** Units of measure as applied to a process variable. Contrast with *SI units*.

**enhancements** Hardware or software improvements, additions, or updates to a computer or software system. See *patch*.

**ENIAC** Acronym for Electronic Numerical Integrator and Calculator, the first large-scale all-electronic digital computer. Built by John Mauchly and J. Presper Eckert at the Moore School of Electrical Engineering, University of Pennsylvania, in 1946. Occupied 1500 sq. ft, weighed about 30 tons, contained approximately 18 000 vacuum tubes, and required 130 kw of power. The computing elements consisted of many components with about one million hand-soldered connections. The input/output system was modified IBM card readers and punches. ENIAC could perform 5000 additions per second, relatively slow by today's standards. But in 1946, the only machine that could even compete with it was the ASCC relay calculator, which performed only 10 additions per second. ENIAC made all relay calculators obsolete. It could perform several additions, a multiplication, and a square root in parallel, as well as solve several independent problems at the same time. ENIAC was so successful that it marked the end of the pioneer stage of automatic computer development. After nine years of operation, ENIAC was retired from service in 1955. See *Eckert, J. Presper* and *Mauchly, John*.

**E notation** System of notation used to express very large and very small numbers. Consists of two parts: a *mantissa* and an *exponent*. Also called *scientific notation*.

**ENTER key** Special key on some keyboards that means "execute a command." Same as *RETURN* key on some keyboards. Often used interchangeably with *carriage return*. See *immediate-mode commands*.

**entity** Any object that has meaning for a particular application. A computer system may be an entity; a job position, a company, or even a technique or concept could be an entity as well.

**entry** In an electronic spreadsheet, the value or information contained within a specific cell.

**entry point** Any location in a routine to which control can be passed by another routine. Also referred to as the transfer address. Often the first instruction to be executed in a program.

**environment** In a computing context, this is more likely to refer to the mode of operation, such as a time-sharing environment, than to physical conditions of temperature, humidity, and so forth. But either kind of environment may affect operational efficiency.

**environment division** Second of four main parts of a *COBOL* program.

**EOB** Acronym for *End-Of-Block*.

**EOF** Acronym for *End-Of-File*. When all the records in a file have been processed, the computer is said to have encountered an end-of-file condition.

**EOJ** Acronym for *End-Of-Job*.

**EOLN** Acronym for *End-Of-Line*, a flag indicating the end of a line of data. Sometimes abbreviated *EOL*.

**EOM** Acronym for *End-Of-Messsage*.

**EOT** Acronym for *End-Of-Transmission*.

**EPO** Acronym for *Emergency Power Off*, the circuit, and the buttons activating it, that can turn an entire computer off in an emergency. There may be as many as twenty EPO buttons in a large installation.

**EPROM** Acronym for *Erasable Programmable Read-Only Memory*, a special *PROM* that can be erased under high-intensity ultraviolet light and reprogrammed repeatedly. Compare *EAROM*. Contrast with *ROM*.

**EPROM programmer** Special machine used to program EPROM chips. Compare *PROM programmer*.



**epsilon** Small quantity of something.

**equality** Idea expressed by the equal sign, written = In many programming languages and program designs the = sign is also used as a "replacement symbol." Contrast with *inequality*.

**equation** Mathematical sentence with an = sign between two *arithmetic expressions* that name the same number.  $A + 10 = 6$  is an equation from which A is calculated to be -4.

**equipment** Part of a computer system. See *computer*, *hardware*, and *peripheral equipment*.

**equipment bay** Cabinet or case in which electronic equipment is installed.

**erasable programmable read only memory** See *EPROM*.

**erasable storage** Storage medium that can be erased and reused. Magnetic disk, drum, and tape are media that can be erased and reused; punched cards or punched paper tape cannot.

**erase** To remove data from storage without replacing it.

**erase head** In a domestic tape recorder, the erase head is the device that cleans the tape of earlier signals immediately before new matter is recorded. In a computer storage device based on magnetization of ferric-oxide surfaces—such as tape, card, or disk, but not core—the erase head operates immediately before the write head to perform a precisely similar function.

**ergonomics** Study of the physical relationships between people and their work environment. Adapting machines to the convenience of operators, with the general aim of maximum efficiency and physical wellbeing. Numeric keypads on standard keyboards, detachable keyboards, and tilting display screens are tangible results. See *human engineering*.



Ergonomics

**EROM** Acronym for Erasable ROM. See *EPROM* and *EAROM*.

**error** Any deviation of a computed or a measured quantity from the theoretically correct or true value. Contrast with *fault*, *malfunction*, and *mistake*. See *intermittent error* and *round-off error*.

**error analysis** Branch of numerical analysis concerned with studying the error aspects of numerical analysis procedures. Includes the study of errors that arise in a computation because of the peculiarities of computer arithmetic.

**error checking** (1) Various techniques that test for the valid condition of data. (2) Process by which two telecommunicating computers can verify that the data received was error-free.

**error control** Any plan, implemented by software, hardware, or procedures, to detect and/or correct errors introduced into a data communications system.

**error-correcting code** (1) Code in which each acceptable expression conforms to specific rules of construction. Nonacceptable expressions are also defined. If certain types of errors

## error correction

occur in an acceptable expression, an equivalent will result and the error can be corrected. (2) Code in which the forbidden pulse combination produced by the gain or loss of a bit will indicate which bit is wrong. Same as *self-correcting code*.

**error correction** System that detects and inherently provides correction for errors caused by transmission equipment or facilities.

**error-detecting code** (1) Code in which each expression conforms to specific rules of construction. When expressions occur that do not conform to the rules of these constructions, an error is indicated. (2) Code in which errors produce forbidden combinations. A single error-detecting code produces a forbidden combination if a digit gains or loses a single bit. A double error-detecting code produces a forbidden combination if a digit gains or loses either one or two bits, and so on. Also called *self-checking code*.

**error file** File generated during data processing to retain erroneous information sensed by the computer, often printed as an error report.

**error guessing** Test data selection technique. The selection criterion is to pick values that seem likely to cause errors.

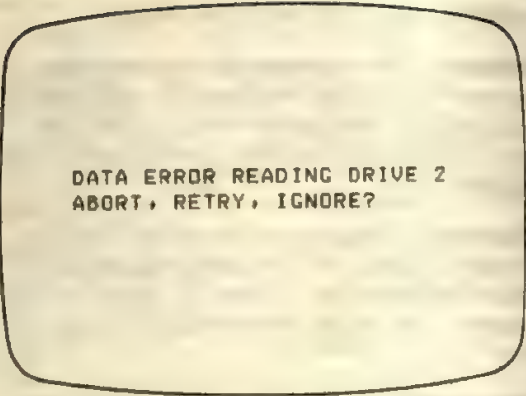
**error handling** Program feature that minimizes the possibility of an error occurring if a keyboard operator pushes the wrong key.

**error message** Printed or displayed statement indicating the computer has detected a mistake or malfunction. See *warning message*.

**error rate** In data communications, a measure of quality of circuit or equipment; the number of erroneous bits or characters in a sample.

**error ratio** Ratio of the number of erroneous data units to the total number of data units.

**error transmission** Change in data resulting from the transmission process. Often a *drop in* or a *drop out*.



DATA ERROR READING DRIVE 2  
ABORT, RETRY, IGNORE?

Error message

**ESCAPE key** Standard control key available on most computer keyboards. Used to take control of the computer away from a program, to escape from a specific program, or to stop a program. Abbreviated ESC.

**Ethernet** Type of network system that allows audio and video information to be carried as well as computer data.

**ETX** Acronym for End-Of-Text.

**evaluation** Process of determining if a newly created computer system is actually doing what it was designed to do. See *system follow-up*.

**event** Any occurrence or happening. Also called *milestone node*, has no time frame associated with it, but typically serves to mark the start or end of activities and to relate activities to each other.

**exception reporting** Technique for screening large amounts of computerized data to display or print reports containing only specific information, especially items outside normal ranges. Plays a key role in management by exception.

**excess-three code** Binary coded decimal notation in which each decimal digit X is represented by the binary numeral of X plus 3.

**exchangeable disk** See *disk pack*.



**exchangeable disk store** Type of disk storage, used as a backing storage, in which the disks come in capsules. Each capsule contains several disks; capsules can be replaced during operation of the computer and stored until needed. The exchangeable capsule is often called a *disk pack*.

**exchange buffering** Technique using data chaining for eliminating the need to move data in internal storage.

**exclusive OR (XOR)** Boolean operator that gives a truth table value of true if only one of the two variables it connects is true. If both variables it connects are true, this value is false. Contrast with *inclusive OR*. Compare *NOR*, *AND*, and *NAND*.

**executable statement** Program statement that gives an instruction or some computational operation to be performed right then, such as an assignment statement. Contrast with *nonexecutable statement*.

**execute** To run a program on a computer or to carry out an instruction.

**execute cycle** Period of time during which a machine instruction is interpreted and the indicated operation is performed on the specified operand.

**execution** Operating cycle during which a program is actually being processed, or *run*.

**execution time** Time it takes for a program to run from start to finish. See *run time*.

**executive** Master program that controls the execution of other programs. Often used synonymously with *monitor*, *supervisory system*, and *operating system*.

**exerciser** Device that enables users to create and debug programs and hardware interfaces by manual means.

**exit** That point in an algorithm or program from which control is transferred elsewhere.

**expandability** Ability to increase the capa-

bility of a computer system by adding modules or devices.

**expansion card** Card added to a system for the purpose of mounting additional chips or circuits to expand the system capability.

**expansion interface** Circuit board that allows one to add disk drives, additional memory, and other peripherals to a basic computer.

**expansion slots** Extra slots in a computer circuit board used for adding new expansion boards to the basic computer. For example, the main memory of a computer can be increased with extra memory boards. Most computers contain expansion slots for these boards to simplify modification.

**expansion unit** Device, connected to a computer, that contains extra sockets into which additional printed circuit boards can be plugged.

**expert-support system** Similar to an *expert system*, but often used in conjunction with decision-support systems to solve problems by examining subjective, intuitive factors, as opposed to formal rules.

**expert system** Methods and techniques for constructing human/machine systems with specialized problem-solving expertise. Pursuit of this area of *artificial intelligence* research has emphasized the knowledge that underlies human expertise and has simultaneously decreased the apparent significance of domain-independent problem-solving theory. Assists or replaces an expert to solve problems.

**explicit address** Storage address explicitly stated in a source-language program. Contrast with *symbolic address*.

**exploded view** Illustration of a solid construction showing its parts separately, but in positions that indicate their relationships to the whole.

**exponent** (1) Symbol or number written above and to the right of another symbol or

## exponential smoothing

number that denotes the number of times the latter is used as a factor. A short way of writing  $10 \times 10$  is  $10^2$ ; 2 is the exponent; 10 is the base. The exponent tells how many times the base is used as a factor. (2) In floating-point notation, exponents are introduced by E; 10E2 means "ten to the exponent 2." See *E notation*.

**exponential smoothing** Weighted, moving-average method of forecasting in which past observations are geometrically discounted according to their age, the heaviest weight being assigned to the most recent data. The smoothing is called exponential because data points are weighted in accordance with an exponential function of their age.

**exponentiation** Process or function that enables the user to calculate the power of a number. For example, the result of nine to the fifth power may be calculated in a single step without multiplying  $9 \times 9 \times 9 \times 9 \times 9$ .

**export** For a database system, to write the data out (usually to a disk file) in a form that other programs can use. Many database programs store their data in some coded form, but will produce for export ASCII files that can be read and edited with a normal text editor. Contrast with *import*.

**expression** (1) General term for numerals, numerals with signs of operation, variables, and combinations of these. See *arithmetic expression*. (2) Any arithmetic formula coded in a programming language.

$$A + B * (C - 364 + D \uparrow 2)$$

Expression

**extended addressing** Addressing mode that can reach any place in memory and requires more than one byte to locate the data in memory

**Extended Binary Coded Decimal Interchange Code** See *EBCDIC*.

**extender board** Debugging aid that allows one to monitor circuit boards more conveniently.

**extensible language** Concept whereby the user adds new features to a programming language by modifying existing ones.

**extension** Additional feature added to a programming language or computer system. Feature beyond what is regularly available in the standard.

**extent** Collection of physical records contiguous in auxiliary storage.

**external data file** Data stored separately from the program that processes it.

**external label** Identification label attached to the outside of a file medium holder identifying the file, such as a paper label or sticker attached to the cover containing a magnetic disk or tape. Contrast with *programmed label*.

**external reference** Reference to a symbol defined in another routine.

**external report** Report produced by an organization for use outside the company, often on *preprinted forms* required by government or for distribution to customers.

**external sort** Second phase of a *multipass sort* program, wherein strings of data are continually merged until one string of sequenced data is formed.

**external storage** Same as *auxiliary storage*.

**external symbol** (1) Control section name, entry point name, or external reference. (2) Symbol contained in the external symbol dictionary

**external symbol dictionary** Control information associated with an object program that identifies the external symbols in the program.

**extract** To remove specific information from a computer word as determined by a *mask* or filter.



# F

**f** Abbreviation for *frequency*.

**fabricated language** Same as *symbolic language*.

**fabrication** Processing of manufacturing materials to desired specifications. See *computer-aided manufacturing*.

**face** In computer graphics, a polyhedron, such as a cube or a prism, is a solid formed by parts of planes, which are called faces of the solid. A cube has six faces.

**FACE** Acronym for *Field Alterable Control Element*.

**facilities** General term that applies to physical equipment, electrical power, communication lines, and other items used in computer and data communications centers. See *transmission facility*.

**facilities management** Use of an independent service organization to operate and manage a data processing installation.

**facility** (1) Measure of the ease of use of a computer system, a major factor in determining a system's *productivity*. (2) *Channel* for electrical transmission between two points.

**facsimile** (1) Transmission of pictures, maps, diagrams, and so on. The image is scanned at the transmitter, reconstructed at the receiving station, and duplicated on some form of paper. Also called *telecopying*. (2) Precise reproduction of an original document; exact copy. (3) Hard-copy reproduction. Abbreviated *FAX*.

**facsimile transceiver** Unit used to transmit and receive electronic transmissions of images.

**factor analysis** Mathematical technique for studying the interaction of many factors to determine the most significant factors and the degree of significance.

**factorial** Product of factors, computed by multiplying all integers from 1 to a specified number. The exclamation point (!) is used to represent factorial. For example,  $4! = 1 \times 2 \times 3 \times 4$ ;  $n! = 1 \times 2 \times 3 \times 4 \dots (n-1) \times n$

**fail-safe system** System designed to avoid catastrophe, possibly at the expense of convenience. For example, when a fault is detected in a computer-controlled traffic light system, a fail-safe arrangement might be to set all the traffic lights to red rather than turn them off. Similarly, in a power plant operation, overheating might simply disconnect the power supply. See *fail-soft system*.

**fail-soft system** System that continues to process data despite the failure of parts of the system. Usually accompanied by a deterioration in performance. Using the two examples described under *fail-safe system*, the traffic lights might turn to flashing amber rather than red, and the overheat system might maintain battery power for emergency equipment while the main source of power was turned off. See *graceful degradation*.

**failure prediction** Technique that attempts to determine the failure schedule of specific

parts or equipment so they may be discarded and replaced before failure occurs.

**fairness** Condition that holds when every action requested in a system is guaranteed to execute after a finite amount of time

**fall-back** Backup system brought into use in an emergency situation, especially the reserve database and programs that would be switched in quickly, or even automatically, in the event of a detected fault in a real-time system

**fallout** Failure of electronic components sometimes experienced during the burn-in of a new piece of equipment.

**family of computers** Series of central processing units allegedly of the same logical design but of different speeds and main storage capacities. Enables users to start with a slower, less expensive CPU and grow to a faster, more expensive one as the workload builds up, without having to change the rest of the computer system.

**FAMOS** Acronym for Floating gate Avalanche injection MOS, a fabrication technology for charge storage devices such as PROMs.

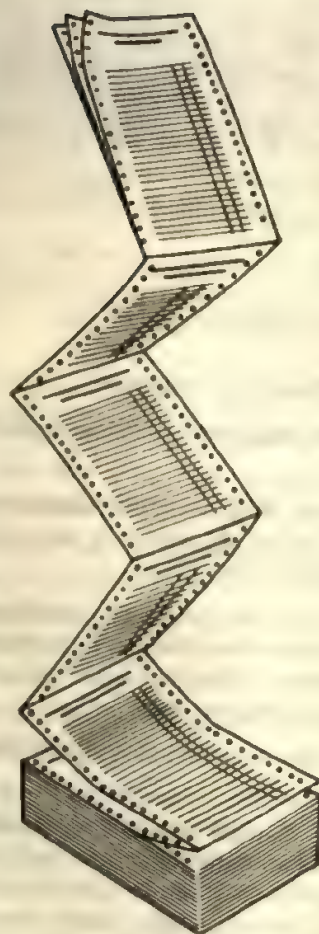
**fanfold paper** One long continuous sheet of paper perforated at regular intervals to mark page boundaries and folded fan-style into a stack. Contrast with *roll paper*.

**fan-in** Number of signal inputs to a digital component.

**fan-out** (1) Number of TTL unit loads a given TTL device output can supply or drive under the worst-case conditions. (2) Number of programming modules below any given module in a structured program.

**farad** Unit of measure of capacitance. A capacitor has a capacitance of 1 farad if it will store a charge of 1 coulomb when a 1-volt potential is applied across it.

**fatal error** Unexpected failure or other problem that occurs while the program is executing. Prevents the computer from continuing to



Fanfold paper

execute the program. If the error is nonfatal, the program will proceed, but not correctly. An operator's mistake that causes the program to *crash*, destroying the data stored in RAM, would be a fatal error. Also called *terminal error*.

**fat bits** Selection on a painting and drawing program that enlarges a portion of the screen to allow precise manipulation of individual screen elements. Useful for precision work or font designing.

**father file** System of updating records that



retains a copy of the original record as well as provides an amended version. When a file-update program is run, the old master file is termed the father file. The updated file is termed the son file. The file that was used to create the father file is termed the grandfather file. The technique is particularly applicable to files held on magnetic media, such as disk or tape.

**fault** Condition, such as a broken wire or a short circuit, that causes a component, a computer, or a peripheral device not to perform to its design specifications. Contrast with *error* and *mistake*. See *malfunction*.

**fault tolerance** Capability of a system to perform its function in accordance with design specifications, even in the presence of hardware or software failures. If, in the event of faults, the system functions can be performed but do not meet the design specifications with respect to the time required to complete the job or the storage capacity required for the job, the system is said to be partially or quasi fault-tolerant. Provided by the application of protective reliability, these resources may consist of more hardware, software, time, or a combination of all three.

**FAX** (1) *Facsimile*. (2) Equipment configuration that facilitates the transmission of images over a common carrier network.

**FCC** Acronym for Federal Communications Commission, an organization of the U. S. Government responsible for regulating interstate communications, communications common carriers, and the broadcast media.

**FE** Acronym for *Field Engineer*.

**feasibility study** Study concerned with a definition of a data processing problem, together with alternative solutions, a recommended course of action, and a working plan for designing and installing the system. Also called *preliminary study* and *systems study*.

**feature** Something special accomplished in a program or hardware device, such as the ability

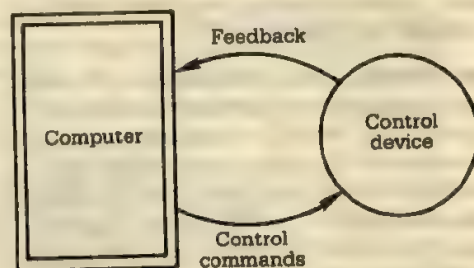
of a word processing program to justify the right margin of text.

**feature extraction** Selection of dominant characteristics for pattern recognition. Enables a computer-controlled video camera to recognize objects by such features as shapes and edges.

**Federal Privacy Act** Federal legislation prohibiting secret personnel files from being kept on individuals by government agencies or contractors. Allows individuals to know what information about them is on file and how it is used within all government agencies and their contractors. Also known as Privacy Act of 1974.

**feed** Mechanical process whereby lengthy materials—such as paper or magnetic tape, line printer paper, and printer ribbon—are moved along the required operating position. See *friction-feed* and *tractor-feed mechanism*.

**feedback** (1) Means of automatic control in which the actual state of a process is measured and used to obtain a quantity that modifies the input to initiate the activity of the control system. (2) In data processing, information arising from a particular stage of processing could provide a feedback to affect the processing of subsequent data; for example, the fact that an area of storage was nearly full might either delay the acceptance of more data or divert it to some other storage area. (3) Any process whereby output from a sequential task serves to modify subsequent tasks.



Feedback

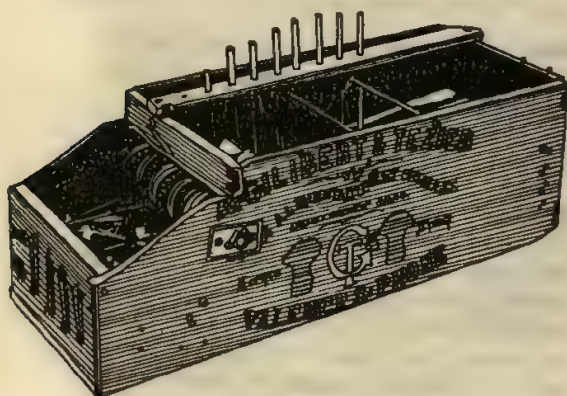
## feedback circuit

**feedback circuit** Circuit that returns a portion of the output signal of an electronic circuit or control system to the input of the circuit or the system.

**feed holes** Holes punched in a paper tape to enable it to be driven by a sprocket wheel.

**feep** Another name for the *beep* that terminals make to get the user's attention.

**Felt, Dorr** (1862–1930) In 1885, designed an experimental multiple-order key-driven calculating machine. Two years later he produced the Comptometer, a practical adding/listing machine.



Felt's calculating machine

**female connector** Recessed portion of a connecting device into which another part fits. See *connector* and *jack*. Contrast with *male connector*.

**femto** Prefix indicating one quadrillionth, or a millionth of a billionth,  $10^{-15}$

**femtosecond** One quadrillionth of a second. There are as many of them (the number one followed by 15 zeros) in one second as there are seconds in 30 million years. In two seconds, light travels from Earth past the moon. In 12 femtoseconds, it moves only five microns, roughly one-tenth the width of a human hair. Abbreviated fs.

**ferrous oxide** Substance that coats record-

ing disks and tapes. Can be magnetized, thereby permitting information to be recorded on it magnetically.

**FET** Acronym for *Field Effect Transistor*. See *MOSFET*.

**fetch** To locate and load a quantity of instructions or data from storage. Compare *get*.

**FF** Acronym for *Form Feed*.

**fiber optics** Data transmission medium made of tiny threads of glass or plastic that transmits huge amounts of data at the speed of light. See *light guide* and *optical fiber*.

**fiche** Microfiche. Sheet of photographic film containing multiple microimages. See *COM*.

**field** Single piece of information, the smallest unit normally manipulated by a *database management system*. In a personnel file, the person's name and age would be separate fields. A *record* is made up of one or more fields.

**field alterable control element (FACE)** Chip used in some systems to allow the user to write microprograms.

**fielddata code** U.S. military code used in data processing as a compromise between conflicting manufacturer's codes.

**field effect transistor (FET)** Three-terminal semiconductor device that acts as a variable charge storage element. The most commonly used type in microcomputers is the Metallic Oxide Semiconductor (MOS) transistor. See *MOSFET*.

**field emission** Emission of electrons from a metal or semiconductor into a vacuum under the influence of a strong electric field.

**field engineer (FE)** Individual responsible for field maintenance of computer hardware and software. Also called *customer engineer*.

**field of view** In computer graphics, the limits of what a simulated camera can see, usually expressed as a horizontal angle centered at the camera. For simplicity of computation, comput-



er graphicists assume that what a camera sees lies within a pyramid—rather than a cone—with the apex at the camera.

**field upgradable** Hardware capable of being enhanced in the field (in one's office or at a local repair center or computer store).

**FIFO** Acronym for First In-First Out, a method of storing and retrieving items from a list, table, or stack, such that the first element stored is the first one retrieved. Same as *LIFO*. Contrast with *LIFO*.

**fifth generation computers** Next phase of computers, expected to be marked by extensive use of audio input/output and artificial intelligence techniques to produce machines that can reason, learn, and make decisions. Compare *first generation computers*, *second generation computers*, *third generation computers*, and *fourth generation computers*.

**figure shift** Keyboard key, or the code generated by the key, signifying that the following characters are to be read as figures until a *letter shift* appears in the message.

**file** Collection of related records treated as a basic unit of storage.

**file backup** Copies of data files that can be used to reactivate (restore) a database that has been damaged or destroyed.

**file conversion** Process of changing the file medium or structure.

**file gap** Space at the end of the file that signifies to the system where the file terminates. Not synonymous with *interblock gap*.

**file handling routine** That part of a computer program that reads data from, and writes data to, a file.

**file label** External label identifying a file.

**file layout** Arrangement and structure of data in a file, including the sequence and size of its components.

**file level model** Model concerned with defining data structures for optimum performance of database application programs or queries.

**file librarian** Person responsible for the safekeeping of all computer files, such as programs and data files on disk packs, magnetic tapes, punched cards, and microfilm. See *custodian*, *librarian*, and *tape librarian*.

**file maintenance** Updating of a file to reflect the effects of nonperiodic changes by adding, altering, or deleting data. Contrast with *file processing*.

**file manager** Simple database management program that uses only simple files and indexes. Also called record manager. Little brother to a *database management system*.

**filename** Alphanumeric characters used to identify a particular file.

**filename extension** Code that forms the second part of a filename and that is separated from the filename by a period. Identifies the kind of data in the file.

**file organization** Manner in which the applications programmer views the data.

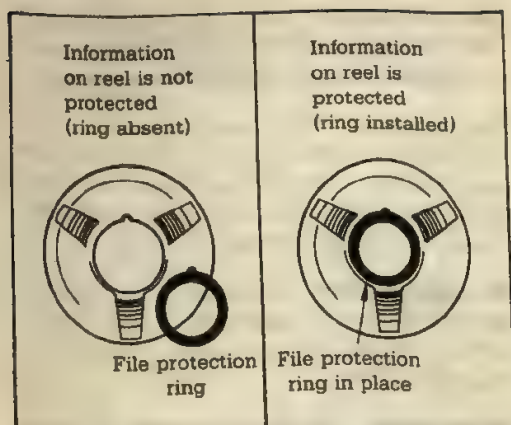
**file processing** Periodic updating of master files to reflect the effects of current data, often transaction data contained in detail files, such as a monthly inventory run updating the master inventory file. Contrast with *file maintenance*.

**file protection** Technique or device used to prevent accidental erasure of data from a file, such as a magnetic tape *file-protect ring* or gummed tab over the *write-protect* notch of a floppy disk.

**file-protect ring** Device used to protect data on magnetic tape. Accidental writing on the tape is prevented by removing the ring from the tape reel. Same as *write-protect ring*. Compare *write-enable ring*. (See page 118.)

**file size** Number of records in a file.

## file storage



File-protect ring

**file storage** Devices that can hold a reservoir of mass data within the computer system, such as magnetic disk, tape, and card units.

**file structure** Format of fields within a data record. For example, PART NAME in the first field of a record, PART NUMBER in the second field, PRICE in the third field, and so on, specify the structure of a file.

**file transfer** Movement of a file from one place to another, or from one storage medium to another.

**filling** In computer graphics, a software function that allows the interior of a defined area to be filled with a color, shading, or *hatching* of the operator's choosing. See *shading symbols*.

**film developer** Equipment used to develop microfilm for COM devices.

**FILO** Acronym for First In-Last Out, a method of storing and retrieving items from a list, table, or stack, such that the first element stored is the last one retrieved. Same as *LIFO*. Contrast with *FIFO*.

**filter** See *mask*.

**find and replace** See *search and replace*.

**finder** Central element of the Apple Macintosh operating environment, a program that,

among other things, displays and organizes files stored on disks.

**finite** To have limits, an end, or a last number. Not infinite.

**finite element method** Approximation technique used to solve field problems in various engineering fields.

**firmware** Program permanently held in a ROM cartridge, as compared to a software program held outside a computer, such as on disk or tape.

**first generation computers** First commercially available computers, introduced with UNIVAC I in 1951 and terminated with the development of fully transistorized computers in 1959. Characterized by their use of vacuum tubes, they are now museum pieces. Compare *second generation computers*, *third generation computers*, *fourth generation computers*, and *fifth generation computers*.

**first in-first out** See *FIFO*.

**first-order predicate logic** Form of logic, used in PROLOG, that allows assertions to be made about the variables in a proposition.

**fitting** In computer graphics, the calculation of a curve, surface, or line that fits most accurately to a set of data points and design criteria. Compare *curve fitting*.

**fixed** Pertaining to a field that always exists within a data record.

**fixed area** Portion of internal storage that has been assigned to specific programs or data areas.

**fixed-head disk unit** Storage device consisting of one or more magnetically coded disks on the surface of which data is stored in the form of magnetic spots arranged in a manner to represent binary data. The data are arranged in circular tracks around the disks and are accessible for reading and writing by read/write heads assigned one per track. Data from a given track are read or written sequentially



as the disk rotates under or over the read/write head. Contrast with *movable-head disk unit*.

**fixed-length record** Record that always contains the same number of characters. Contrast with *variable-length record*.

**fixed point** Pertaining to a number system in which each number is represented by a single set of digits, and the position of the radix point is implied by the manner in which the numbers are used. Contrast with *floating point*.

**fixed-point arithmetic** (1) Method of calculation in which the operations take place in an invariant manner without considering the location of the radix point. Illustrated by desk calculators that require the operator to keep track of the decimal point. This occurs similarly with many automatic computers, in which the location of the radix point is the computer user's responsibility. Contrast with *floating-point arithmetic*. (2) Type of arithmetic in which the operands and results of all arithmetic operations must be properly scaled to have a magnitude between certain fixed values.

**fixed-program computer** See *wired-program computer*.

**fixed-size records** File elements, each of which has the same number of words, characters, bytes, bits, fields, and so on.

**fixed spacing** Printing of characters at fixed horizontal intervals on a page.

**fixed storage** Storage whose contents are not alterable by computer instructions, such as *read-only storage*.

**fixed word length** Pertaining to a machine word or operand that always has the same number of bits, bytes, or characters. Contrast with *variable word length*.

**flag** (1) Indicator used frequently to tell some later part of a program that some condition occurred earlier, such as an overflow or carry. (2) Symbol used to mark a record for special

attention. For example, on a listing of a program, all statements that contain errors may be flagged for the attention of the program writer. (3) Indicator of special conditions, such as interrupts.

**flatbed plotter** Digital *plotter* using plotting heads that move over a flat surface in both vertical and horizontal directions. Contrast with *drum plotter*.

**flat pack** Small, low-profile (flat), integrated circuit package that can be spot-welded or soldered to a terminal or a printed circuit board. The pins extend outward rather than pointing down, as on a *DIP*.

**flat panel display terminal** Thin-screened peripheral device upon which information may be displayed, such as a *plasma display panel*.

**flat screen** Thin panel screen, such as those found on flat panel displays.

**flexible disk** See *floppy disk*.

**flexowriter** Form of typewriter accepting paper tape input. Used as an input/output device with many older computers.

**flicker** Undesirable, unsteady lighting of a display due to inadequate refresh rate and/or fast persistence. Occurs whenever the refresh speed is not fast enough to compensate for natural luminance delay on the screen. See *refreshing*.

**flight computer** Computer resident in a spacecraft, an airplane, or a missile.

**flight simulator** Computer-controlled simulator used by airline companies to train pilots on new aircraft. Some are so realistic that they are acceptable to the FAA for use in renewal of pilot licenses.

**flip-flop** Device or circuit containing active elements capable of assuming either one of two stable states at a given time. Synonymous with *toggle*.

**flippy** Synonymous with *floppy disk*.

## float

**float** Amount of time following the completion of a task or activity and prior to the start of the next task or activity. Also called *slack time*.

**floating point** Form of number representation in which quantities are represented by a number called the *mantissa* multiplied by a power of the number base. Contrast with *fixed point*. See *characteristic*.

**floating-point arithmetic** Method of calculation that automatically accounts for the location of the radix point. Contrast with *fixed-point arithmetic*.

**floating-point BASIC** Type of BASIC language that allows the use of decimal numbers.

**floating-point constant** Number, usually consisting of two parts, with one part containing the fractional component of the number; the other part is expressed as a power of the radix (base) of the number. Also called *real constant*.

**floating-point operation** Operation done with *floating-point arithmetic*.

**floating-point routine** Set of subroutines that cause a computer to execute floating-point operations on a computer with no built-in floating-point hardware.

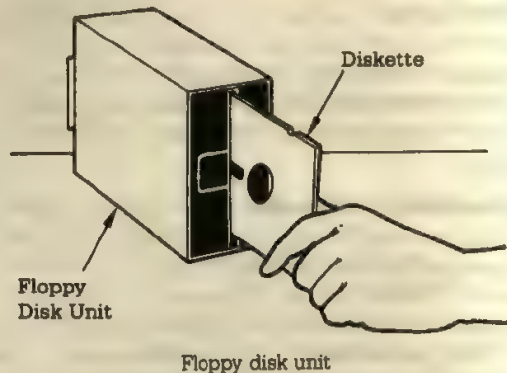
**FLOP** Acronym for *Floating-Point Operation*.

**floppy disk** Flexible disk (*diskette*) of oxide-coated mylar stored in paper or plastic envelopes. The entire envelope is inserted in the disk unit. Used widely with minicomputers and microcomputers, provides comparatively low-capacity storage at low cost and with relatively low data transfer rates. Regular floppy disks have a diameter of 20.32 cm (8 in.), mini floppy disks have a diameter of 13.3 cm (5  $\frac{1}{4}$  in.), and micro floppy disks have a diameter of less than 9 cm (3  $\frac{1}{2}$  in.). See *magnetic disk*, *diskette*. Contrast with *hard disk*.

**floppy disk case** Container, usually made of plastic, for storing and protecting floppy disks. See *diskette tray*.

**floppy disk controller** Circuit board or chip that controls a floppy disk unit.

**floppy disk unit** Peripheral storage device in which data are recorded on magnetizable floppy disks.



**flowchart** Diagram that uses symbols and interconnecting lines to show (1) the logic and sequence of specific program operations (*program flowchart*) or (2) a system of processing to achieve objectives (*system flowchart*). Sometimes called *block diagram*. Compare *structured flowchart*.

**flowcharter** Computer program that automatically generates flowcharts with a visual display screen, digital plotter, or printer.

**flowcharting symbol** Symbol used to represent operations, dataflow, or equipment on a flowchart. See *annotation symbol*, *connector symbol*, *decision symbol*, *input/output symbol*, *processing symbol*, and *terminal symbol*. (See page 122.)

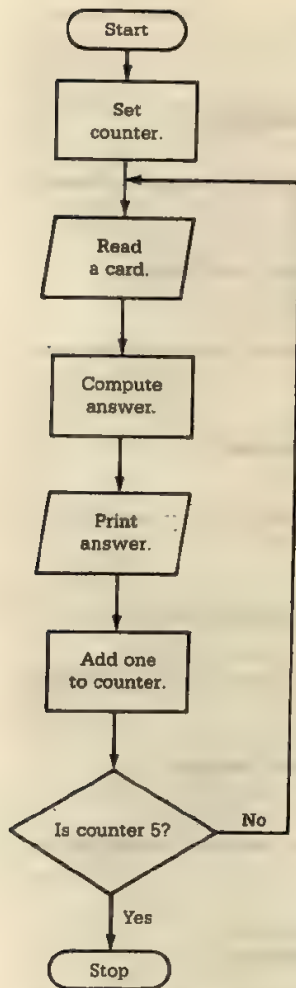
**flowchart template** Plastic guide that contains cutouts of the flowchart symbols and is used in the preparation of a flowchart.

**flowchart text** Descriptive information associated with flowchart symbols.

**flow diagram** See *flowchart*.

**flowline** On a flowchart, a line representing a connecting path between flowchart symbols.





Flowchart

Normal directions are downward and to the right; flowlines going upward or to the left must indicate their directions by arrowheads.

**flush** (1) To empty a portion of storage of its contents. (2) Pertaining to type set in alignment with the left (flush left) or right (flush right) edge of the line measure. See *justification*.

**FM** Acronym for Frequency Modulation, the

process of changing the value represented by a signal by varying the frequency of the signal.

**focusing** Sharpening a blurred image on a display screen.

**font** Complete set of characters in a consistent and unique typeface.

**footer** Information printed at the bottom of a page, such as page numbers. Most word processors can automatically print footers on each page of a document.

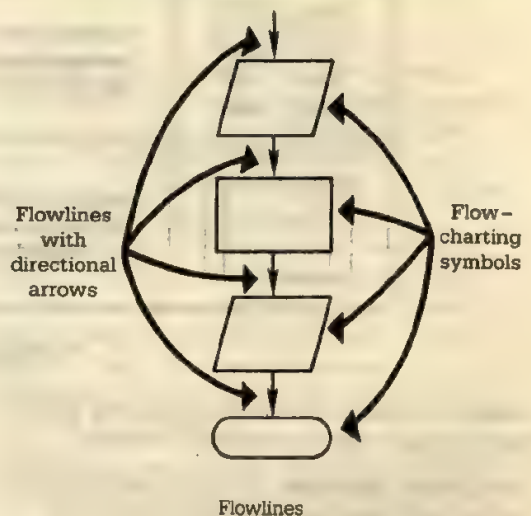
**footprint** Shape and area of floor space required for a piece of equipment.

**force** To intervene manually in a program and cause the computer to execute a *jump* instruction.

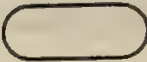







**forecast** Extrapolation of the past into the future. Usually an objective computation involving data, as opposed to a prediction, which is a subjective estimate incorporating the manager's anticipation of changes and new influencing factors.

**foreground job** See *foreground program*.

**foreground processing** Automatic execution of computer programs that have been de-



## foreground program

	<b>TERMINAL</b> Represents the start or end of a program
	<b>PROCESS</b> Represents calculations, processing, or any function not covered by a specific symbol
	<b>INPUT/OUTPUT</b> Represents an input or output function
	<b>DECISION</b> Represents a question, decision, or comparison
	<b>ANNOTATION</b> Contains descriptive comments or clarifying notes about the program
 On page  Off page	<b>CONNECTOR</b> Represents an entry from, or an exit to, another part of the program flowchart
	<b>PREDEFINED PROCESS</b> Represents a subroutine (a group of operations not detailed in the particular set of flowcharts)

Flowcharting symbols

signed to preempt the use of computing facilities. Contrast with *background processing*.

**foreground program** Program that has high priority and therefore takes precedence over

concurrently operating programs in a computer system using multiprogramming techniques. Contrast with *background program*.

**foreground task** See *foreground program*.



**forest** Collection of trees.

**form** (1) Preprinted document requiring additional information to make it meaningful. (2) Format of program output.

**formal language** Abstract mathematical objects used to model the syntax of programming languages, such as COBOL or BASIC, or of natural languages, such as English or French.

**formal logic** Study of the structure and form of valid argument without regard to the meaning of the terms of the argument.

**format** (1) Specific arrangement of data. (2) Programming associated with setting up text arrangements for output.

**formatted display** Screen display in which the attributes or contents of one or more display fields have been defined by the user.

**formatter** Section of a word processing program that formats the text.

**form feed (FF)** (1) Physical transport of continuous paper to the beginning of a new line or page. (2) Standard ASCII character that causes a form feed to occur. See *line feed*.

**form letter program** Program that produces form letters. Also called *merge-print program*.

**forms control** Operational procedure established by an organization to exercise direction in the utilization of documents used to collect and/or report information.

**forms design** Creation of data input forms and source documents.

**formula** Rule expressed as an equation; for example,  $C=2\pi r$  is the formula for finding the circumference of a circle. Way of showing the equal relationship between certain quantities; especially useful for calculating one quantity when given others.

**Forrester, Jay** Leader in the area of system dynamics; developed magnetic core, an internal memory used in most computers between

1951 and 1964. Headed the team of people at M.I.T. who built the Whirlwind computer, perhaps the most influential of the early computers in terms of today's commercial machines. Both magnetic core memory and the parallel synchronous method for handling information inside the machine were first developed by Whirlwind's designers.



Jay Forrester

**FORTH** Programming language for use in functional programming. Has a specific orientation toward productivity, reliability, and efficiency. Capabilities include structured programming, top-down development, and virtual memory. Has been described as a macrolanguage for a virtual stack machine. Implemented by a series of *primitives* generated in machine language; the remainder of the language is compiled from either source files on disk or input from a terminal. Developed primarily for use on microcomputer systems. (See page 124.)

**FORTRAN** Acronym for FORmula TRANslator, widely used high-level programming language used to perform mathematical, scientific

## FORTRAN-77

ic, and engineering computations. Has been approved as an American Standard programming language in two versions, FORTRAN and *Basic FORTRAN*.

**FORTRAN-77** Version of FORTRAN that conforms to the ANSI X3.9-1978 standard, with added features for use in microcomputer environments

**FORTRAN translation process** Process used to produce computed results from a program written in FORTRAN. Includes compiling and executing the program on the computer.

**forward chaining** Event-driven method of reasoning that proceeds from known conditions to the desired goal. Contrast with *backward chaining*.

**forward pointer** Pointer that tells the location of the next item in a data structure.

**FOSDIC** Acronym for Film Optical Sensing Device for Input to Computers, an input device used by the Census Bureau to read completed census questionnaire data into a computer.

**four-address instruction** Machine instruction that usually consists of the addresses of two operands, the address for storing the result, the address of the next instruction, the command to be executed, and miscellaneous indices. See *multiple-address instruction*.

**four-out-of-eight code** Code for error detection.

### fourth generation computers

Contemporary digital computers developed from very large scale integration (VLSI) technology. Compare *first generation computers*, *second generation computers*, *third generation computers*, and *fifth generation computers*.

**FPLA** Acronym for Field Programmable Logic Array, a PLA that can be programmed by the user in the field, whereas an ordinary PLA is programmable only by masking at the semiconductor manufacturer's factory

**fractals** Branch of mathematics recently codified by Benoit Mandelbrot that deals with curves and surfaces with nonintegral, or fractional, dimension. In computer graphics appli-

```
: TASK! 200 CONSTANT TOP
: CHECK MOD IF 2 + ELSE 0 THEN;
: TEST BEGIN OVER OVER > IF OVER OVER
  CHECK DUP ELSE 0 THEN 0 + END;
: PRIME WHILE OVER TOP SWAP > PERFORM TEST
  IF DUP, ELSE DROP THEN 2 + 3 P END
  DROP DROP;
: RUN 3 3 CR PRIME;
RUN FORGET TASK
```

FORTH



C FOR COMMENT										FORTRAN STATEMENT									
STATEMENT NUMBER	5	10	15	20	25	30	35	40											
C	PERMUTATIONS																		
	INTEGER R,P																		
10	READ(5,20)N,R																		
20	FORMAT(2I3)																		
	IF(N.EQ.0) GO TO 50																		
	P = 1																		
	L = N - R + 1																		
	DO 30 K = L,N																		
	P = P * K																		
30	CONTINUE																		
	WRITE(3,40) N,R,P																		
40	FORMAT(1H,I3,12HTHINGS TAKEN,I3,																		
	211HAT A TIME =,I9)																		
	GO TO 10																		
50	STOP																		
	END																		

FORTRAN

cations, this relates to a technique for obtaining a degree of complexity analogous to that in nature from a handful of data points. Contrast with *texture*.

**fragmentation** Presence of small increments of unused main memory space spread throughout main storage.

**frame** (1) Video image produced by one complete scan of the screen of a raster-scan display unit. (2) Area, one recording position long, extending across the width of a paper or magnetic tape perpendicular to its movement. Several bit or punch positions may be included in a single frame through the use of different recording positions across the width of the tape.

**framebuffer** In computer graphics, an espe-

cially adapted piece of digital memory for storing a computed picture.

**Freedom of Information Act** Federal legislation that allows ordinary citizens access to data gathered by federal agencies. *See* **Federal Privacy Act**.

**free form** Type of optical scanning in which the scanning operation is controlled by symbols entered by the input device at the time of data entry.

**freeware** Software provided by a vendor at no charge.

**frequency** Number of times that sound pressure, electrical intensity, or other quantities specifying a wave vary from their equilibrium value through a complete cycle in unit time. The most common unit of frequency is the hertz (Hz); 1 Hz is equal to 1 cycle per second.

frequency counter

**frequency counter** Electronic device capable of counting the number of cycles in an electrical signal during a preselected time interval.

**frequency shift keying (FSK)** Method of data transmission in which the state of the bit being transmitted is indicated by an audible tone

**friction-feed** Paper-feed system that operates by clamping a sheet of paper between two rollers. As the rollers rotate, the paper is drawn into the printing device. Typewriters and many printers use this method, which is effective for single-sheet feeding. Contrast with *tractor-feed mechanism*.

**friendliness** How easy to work with a computer or program is. A *user-friendly* program is one that takes little time to learn and is easy to use.

**friendly interface** Term applied to a combination of terminal equipment and computer program designed to be easy to operate by casual users of computers.

**frob** To fiddle with a picking device, such as a joystick or mouse.

**front-end processor** Dedicated communications computer at the front end of a host computer. May perform communications line assignment, data conversion, error analysis, message handling, and other data communications functions, freeing the host computer from these tasks. Compare *input/output processor*.

**front panel** Collection of switches and indicators by which the computer operator may control a computer system. Same as *control panel*.

**fry** To ruin circuitry by subjecting it to excessive heat or current.

**fs** Abbreviation for *femtosecond*.

**FSK** Acronym for *Frequency Shift Keying*.

**full adder** Computer circuit capable of adding three binary bits, one of which is a *carry* from a previous addition.

**full-duplex** Pertaining to the simultaneous, independent transmission of data in both directions over a communications link. Contrast with *half-duplex* and *simplex*.

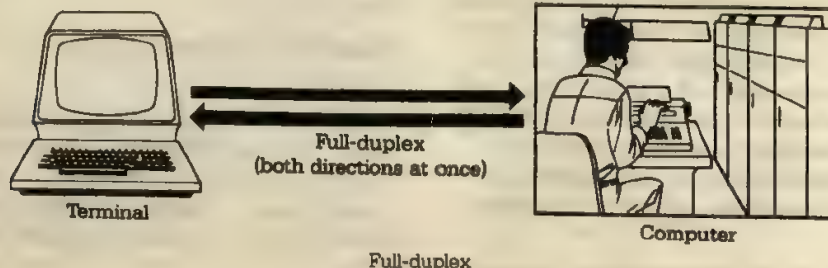
**full frame** Process by which a display image is scaled to use the entire viewing area of a display device.

**full-page display** Terminal, used in word processing systems, that displays a standard 21 x 28 cm (8 1/2 x 11 in.) page of text on the screen at one time

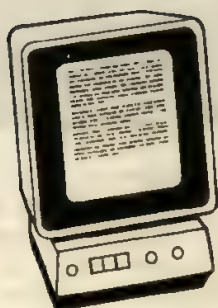
**full screen** Condition in which the entire face of the video screen is used for display.

**full-screen editing** Ability to move the cursor over the entire screen to alter text.

**full-text searching** Retrieval of certain information by searching the full text of an article or book stored in a computer's auxiliary storage.







Full-page display

**fully formed characters** Printed characters, such as those of a typewriter or daisy wheel printer, as opposed to dot matrix characters.

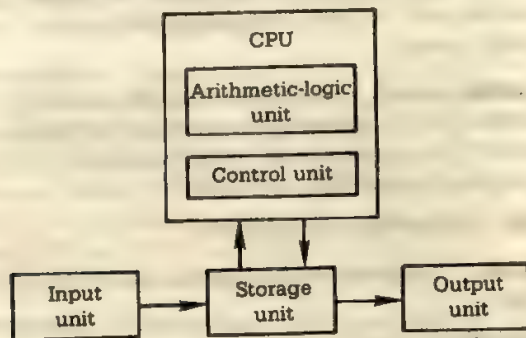
**function** (1) Process that generates a value. (2) Precoded routine. See *subroutine*. (3) In business, a job.

**functional description** Phrase used to identify the requirements of a computer system.

**functional design** Specification of the working relationships between the parts of a system in terms of their characteristic actions.

**functional programming** Programming that uses function application as the only control structure.

**functional specification** Set of input, processing, output, and storage requirements detailing what a new system should be able to do. Output of the *systems analysis* function, it



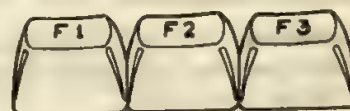
Functional units of a computer

presents a detailed, logical description of a new system.

**functional units of a computer** In digital computers, the arithmetic-logic unit, storage unit, control unit, input device, and output device.

**function codes** Special codes that help control functions of peripheral devices. "Clear display screen" would be a function code.

**function key** Specially designed key that, when pressed, initiates some function on a computer keyboard, word processor, or graphics terminal.



Function keys

**function subprogram** Subprogram that returns a single-value result.

**funware** Game programs in *firmware*.

**fuse** Safety protective device that opens an electric circuit if overloaded. A current above the rating of the fuse will melt a fusible link and open the circuit. Most computer devices use fuses to protect the equipment from current overloads.



Fuse

**fusible link** Widely used PROM programming technique. An excessive current is used to destroy a metalized connection in a storage device, creating a 0, for instance, if a conducting element is interpreted as a 1.

**fuzzy logic** Method of handling imprecision or uncertainty that attaches various measures of credibility to propositions.

# G

**gain** Increase in signal power or voltage produced by an amplifier in transmitting a signal from one point to another. Amount of gain is usually expressed in decibels above a reference level. Opposite of *attenuation*.

**gallium arsenide** Crystalline material used to make high-grade semiconductors. Superior to silicon but far more costly.

**game playing** See *computerized game playing*.

**game theory** Branch of mathematics concerned with probability, among other things. Term was first used by John von Neumann in 1928 to describe the strategy of winning at poker. Mathematical process of selecting an optimum strategy in the face of an opponent who also has a strategy. See *operations research*.

**gamut** Total range of colors that can be displayed on a computer display.

**gang punch** To punch identical or constant information into all of a group of punch cards.

**Gantt chart** Time-based bar, line, or arrow chart depicting start and end points of activities or tasks. Commonly used to depict scheduled deadlines and milestones for a project. Named after its developer, Henry Gantt.

**gap** Magnetic memory space between two records (*interrecord gap*) or two blocks of data (*interblock gap*). Not synonymous with *file gap*.

**garbage** (1) Term often used to describe incorrect answers from a computer program, usually resulting from inaccuracies in data entry or

a mistake in a computer program but sometimes from equipment malfunction. (2) Unwanted and meaningless data carried in storage. (3) Incorrect input to a computer. See *junk* and *GIGO*.

**garbage collection** Loosely, a term for cleaning dead storage locations out of a file.

**gas display** Flat panel display screen filled with an inert gas that glows when current is applied. Character images are formed in a dot matrix fashion by applying power at the appropriate points to make dots of glowing gas. See *plasma display panel*.

**gate** (1) Logic circuit with two or more inputs that control one output. (2) Controlling element of *field effect transistors*, governing current flow from *source* to *drain*.

**gateway** Computer that connects two distinctly different communications networks together. Used so that one local area network computer system can communicate and share its data with another local area network computer system.

**gating circuit** Circuit that operates as a selective switch, allowing conduction only during selected time intervals or when the signal magnitude is within certain limits.

**GB** Abbreviation for *gigabyte*.

**geek** Unsophisticated computer user. See *nerd*.

**GEMISCH** Programming language developed for medical record applications.



**generality** Pertaining to a computer program whose solution of a problem will serve a variety of users with the same general need. A simple example is a payroll program that writes a warning message if calculated net pay is more than a certain amount. A program with less generality would have a fixed limit; a program with more generality would allow each individual user to specify his/her own limit value, or to turn off the warning feature altogether.

**generalized routine** Routine designed to process a large range of specific jobs within a given type of application.

**general-purpose (GP)** Being applicable to a wide variety of uses without essential modification. Contrast with *special-purpose* and *dedicated*.

**general-purpose computer** Computer designed to solve a wide class of problems. Majority of *digital computers* are of this type. Contrast with *special-purpose computer*.

**general-purpose register** CPU *register* used for indexing, addressing, and arithmetic and logical operations.

**general register** Storage device that holds inputs and outputs of the various functional units of a computing system. Also used for temporary storage of intermediate results.

**generate** To produce a program by selection of subsets from a set of skeletal coding under the control of parameters; to produce a program by use of a *generator*.

**generation** Term usually applied to the technological progression of computers from those using vacuum tubes (*first generation computers*) to those using transistors (*second generation computers*), to those using integrated circuits (*third generation computers*), and to those using LSI and VLSI circuits (*fourth generation computers*). See *fifth generation computers*.

**generator** Software package that contains a number of routines to accomplish specific functions. These routines are capable of accepting

input parameters and modifying themselves as the parameters indicate. Used to make the implementation of specific, limited tasks very convenient, such as generating a report. Typically, the user fills out a set of parameter forms defining the task. See *report generator*.

**generic** Pertaining to the next (generally improved) type of an item or device without specific reference to trade names.

**geocoding** Method of providing a graphic display of data in relation to a geographic area.

**geometric model** See *model, geometric*.

**geometry** Branch of mathematics that deals with the relationships, properties, and measurements of solids, surfaces, lines, and angles. Considers spatial relationships, the theory of space, and figures in space. In computer graphics, refers to the specific physical arrangement of lines that make up the shape of a specific entity.

**germanium** Chemical element (atomic number 32) used in the manufacture of chips.

**GERT** Acronym for Graphical Evaluation and Review Technique, a procedure for the formulation and evaluation of systems, using a network approach. Compare *PERT*.

**get** To obtain a record from an input file. Another name for *load*. Compare *fetch*.

**G flops** One billion floating-point operations per second.

**gibberish** Unnecessary data.

**giga** Prefix indicating 1 billion or  $10^9$ . Abbreviated G. Contrast with *nano*, one billionth.

**gigabyte** Specifically, 1 073 741 824, or  $2^{30}$ , bytes. More loosely, one billion bytes, one million *kilobytes*, or one thousand *megabytes*. Abbreviated GB. Compare *terabyte*.

**gigahertz** Frequency of a billion times a second. Abbreviated GHz.

**GIGO** Acronym for Garbage In-Garbage Out,

## glare

a term used to describe the data into and out of a computer system. If the input data is bad (Garbage In), then the output data will also be bad (Garbage Out).

**glare** Reflection from the surface of a display screen.

**glitch** Popular term for a temporary or random malfunction in hardware, such as a malfunction caused by a power surge. Also called snag or snarl. Contrast with *error*.

**global** (1) General term implying a great breadth of scope, as contrasted with *local*. (2) Pertaining to a variable whose name is accessible by a main program and all its subroutines. See *global variable*. (3) Any computer operation applied to a broad set of data.

**global character** Character used in a searching routine to stand for any character. Allows the operator to search for a character string of a specified length by specifying only some of its characters and using global characters to stand for the others. Also called *wild card*.

**global operation** In word processing, an operation performed throughout an entire file.

**global search and replace** In word processing, the ability to find a string anywhere it appears in a document and to substitute another string for it.

**global variable** Variable that has the same value regardless of where or in what program it is used.

**gnomon** Object representing direction and dimension that facilitates interpretation of a two-dimensional image of a three-dimensional solid.

**go down** To crash. See *down*.

**GP** Acronym for *General-Purpose*.

**GPS** Acronym for General Problem Solver, the first program for solving general problems that separated solving methods from knowledge.

**GPSS** Acronym for General Purpose Systems Simulation, a problem-oriented language used to develop simulation systems.

**grabber** Fixture on the end of a test equipment lead wire with a spring-actuated hook and claw designed to connect the measuring instrument to a pin of an integrated circuit, socket, transistor, and so forth.

**graceful degradation** Process of undergoing failure in such a way that limited operation can continue. See *fail-soft system*.

**grade** Pertaining to the range, or width, of the frequencies available for transmission on a given channel, such as *voice-grade*.

**grammar** Rules prescribing how various elements of a language may be combined. See *syntax*.

**grammatical error** Error that results when the rules or syntax of a programming language are not followed. Also called a *syntax error*. See *fatal error*.

**grammatical mistake** See *grammatical error*.

**grandfather file** See *father file*.

**graph** (1) Diagram showing the relationship of two or more variable quantities. A mathematical graph is usually in the form of a curve drawn in a frame of reference formed by the two axes of coordinate geometry. (2) Loosely, a *chart*.

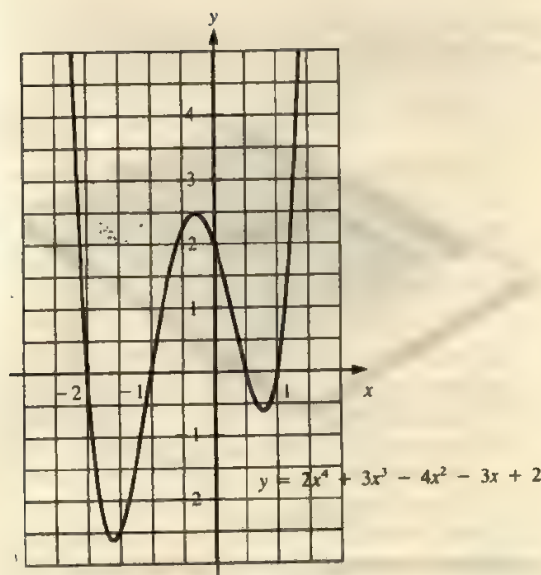
**graphical terminal** Visual display terminal that has a screen to display a drawing as well as textual information.

**graphic data structure** Logical arrangement of digital data representing graphic data for graphic display.

**graphic digitizer** Input device that converts graphic and pictorial data into binary inputs for use in a computer. See *digitizer*.

**graphic display mode** Mode of operation





Graph

that allows the computer to print graphics on a special (graphics) screen.

**graphic display resolution** Number of lines and characters per line able to be shown on a video screen.

**graphic display terminal** Computer terminal that displays information on a screen, usually a cathode ray tube, TV terminal, or video monitor.

**graphic input device** Any device, such as a *digitizer*, that gives the computer the points that make up an image in such a way that the image can be stored, reconstructed, displayed, or manipulated.

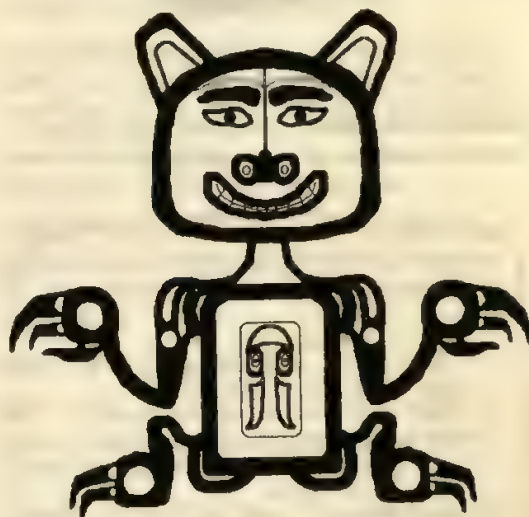
**graphic limits** Plotting area of a graphics device, such as a *digital plotter*, as defined by its mechanical limits, such as the size of the drum or platen.

**graphic output** Computer-generated output in the form of visual displays, printouts, or plots.

**graphic output device** Device used to dis-

play or record an image. A display screen is an output device for soft copy; hard-copy output devices produce paper, film, or transparencies of the image.

**graphics** Any computer-generated picture produced on a screen, paper, or film. Graphics range from simple line or bar graphs to colorful and detailed images. See *business graphics* and *video game*. Contrast with *text*.



Graphics

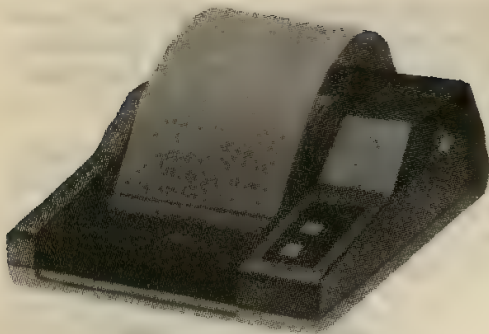
**graphics display** Any output device that can present an image of graphic data derived from a computer system.

**graphics input hardware** Peripherals used to put graphics information in the computer, such as a *graphics tablet*, *mouse*, and *light pen*.

**graphics output hardware** Peripherals on which the computer displays graphics, such as a *graphics screen*, *digital plotter*, or *graphics printer*.

**graphics printer** Output device that can produce text, charts, graphics, and artwork. (See page 132.)

## graphics program



Graphics printer

**graphics program** Computer program that lets the computer produce graphics.

```
NEW
10 GR, 3
20 SETCOLOR 4,7,8
30 COLOR 1:SETCOLOR 0,1,8
40 PLOT 6,2:DRAWTO 6,17
50 PLOT 17,2:DRAWTO 17,17
60 PLOT 6,9:DRAWTO 17,9
70 PLOT 24,6:DRAWTO 24,17
80 PLOT 24,4
90 END
```

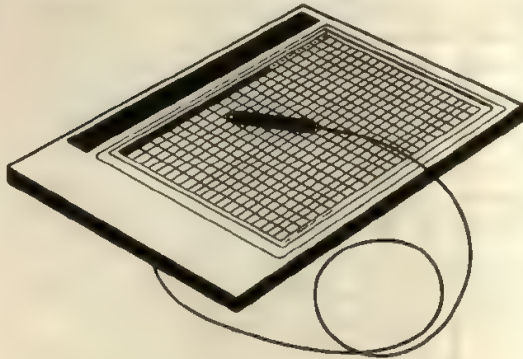
Graphics program

**graphics resolution** Measure of the detail in which graphics can be drawn by output hardware. *High-resolution* pictures have greater detail than *low-resolution* pictures. See *resolution*.

**graphics screen** Screen that displays graphics information. See *cathode ray tube*, *display*, and *video display terminal*.

**graphics tablet** Input device that converts graphic and pictorial data into binary inputs for use in a computer. Provides an efficient method of converting object shapes into computer-

storable information. Utilizes a flat tablet and a stylus for graphic input. See *digitizer*.



Graphics tablet

**graphics terminal** Output device that displays pictures and drawings.

**graph theory** Branch of mathematics that belongs partly to combinatorial analysis and partly to topology. Applications occur in electrical network theory, operations research, statistical mechanics, and sociological and behavioral research.

**gray code** Code having the characteristic of successive integers differing from one another by only one digit. Advantageous in analog-to-digital conversion equipment. Used only for input/output purposes. Coded values must be converted to binary before arithmetic calculations can be performed. Also called *cyclic code* and *reflected code*.

**gray code-to-binary conversion** The binary equivalent of a gray code number can be obtained by applying the following rule, reading from left to right: The most significant binary digit equals the corresponding gray code digit, while the following binary digits change if the gray code digit is a 1 and remain the same if the gray code digit is a zero. For example, the gray code value 110100110 equals the binary number 100111011. Compare *binary-to-gray code conversion*.



**gray scale** In computer graphics systems with a monochromatic display, variations in brightness level (gray scale) are employed to enhance the contrast among various design elements.

**greater than** Relationship of inequality between two values. The symbol is  $>$ , with the point toward the smaller number.  $9 > 5$  means 9 is greater than 5. Commonly used in *comparison* to determine alternative processing. Contrast with *less than*

**grid** (1) Network of uniformly spaced points or crosshatched lines displayed on a visual display screen or digitizer and used for exactly locating a position, inputting components to assist in the creation of a design layout, or constructing precise diagrams. For example, coordinate data supplied by digitizers is automatically calculated by the computer from the closest grid point. The grid determines the minimum accuracy with which design entities are described or connected. (2) Display of an electronic spreadsheet model composed of columns and rows. (3) Horizontal and vertical lines on a chart to aid the viewer in determining the value of a point. (4) On a pie chart, the grid is an implied set of lines radiating out from the center, representing the degrees of a circle.

**grid chart** Table that relates input data to its applicable applications program.

**gridding** Graphic image construction constraint that requires all line endpoints to fall on grid points.

**gridsheet** Same as *grid*, *spreadsheet*, or *worksheet*.

**grounding** Process of rendering electrical current harmless to humans and computers.

**group mark** Any indicator signaling the beginning or end of a word or other unit of data. See *end mark*, *start bit*, and *stop bit*.

**group printing** Operation during which information prints from only the first card of each group passing through an accounting machine.

**guest computer** Computer operating under the control of another (host) computer.

**GUIDE** Acronym for Guidance of Users of Integrated Data processing Equipment, an international association of users of large-scale IBM computers.

**gulp** Small group of bytes.

**gun** Group of electrodes constituting the electron beam emitter in a cathode ray tube. See *electron beam deflection system*.

**gynoid** Humanlike female robot. See *android*.

# H

**hacker** (1) Computer enthusiast who is experienced in using computers and enjoys solving complex or unusual problems on a computer. Often produces programs with little advance planning. Sometimes called computer junkie, a hacker is intensely interested in computers and programming, but not particularly interested in the scientific concepts. Cracker-jack computer hobbyist. Compare *wizard*. (2) Someone who intentionally breaks into other computer systems, whether maliciously or not.

**half adder** Computer circuit capable of adding two binary bits

**half-duplex** Pertaining to a communications path that can carry a message in either direction but only one way at a time. Contrast with *full-duplex* and *simplex*.

**halftoning** Using dot patterns of variable density to simulate gray levels on a display that is strictly black and white.

**halfword** Contiguous sequence of bits, bytes, or characters that comprises half a computer word and is capable of being addressed as a unit. See *word* and *nibble*.

**halting problem** Problem for which there is no algorithm.

**halt instruction** Machine instruction that stops the execution of the program.

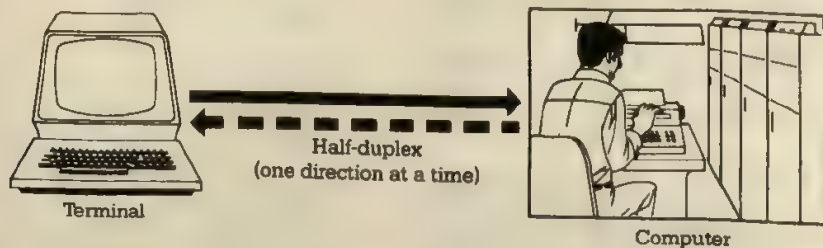
**hamming code** Seven-bit error-correcting data code capable of being corrected automatically.

**hand calculator** Hand-held calculator suitable for performing arithmetic operations, including complicated calculations.

**hand-held computer** Portable, battery-operated computer that can be programmed in BASIC to perform a wide variety of tasks. Also called *pocket computer*.

**handler** Program with the sole function of controlling a particular input, output, or storage device, a file, or the interrupt facility.

**handshaking** Procedures and standards (*protocol*) used by two computers or a computer and a peripheral device to establish communication.



Half-duplex



**hands-on** Pertaining to the process of physically using a computer system.

**handwriting recognition** Scanning handwritten material with a computer-controlled visual scanning device to determine information content or to verify a signature.

**hang-up** Nonprogrammed stop in a routine. Usually an unforeseen or unwanted halt in a machine run caused by improper coding of a problem, by equipment malfunction, or by the attempted use of a nonexistent or illegal operation code.

**hard clip area** Limits beyond which lines cannot be drawn on a digital plotter.

**hard contact printing** Contact printing in which the mask is pressed against the substrate with appreciable force.

**hard copy** Printed copy of machine output in readable form, such as reports, listings, documents, or summaries. Contrast with *soft copy*.

**hard disk** Fast auxiliary storage device either mounted in its own case or permanently mounted inside a computer. A single hard disk has storage capacity of several million characters or bytes of information. Same as *platter*. Contrast with *floppy disk*.

**hard error** Error caused by a malfunction in the hardware. Compare *glitch*.

**hard failure** Failure of a piece of equipment. Generally requires repair before the unit can be used again.

**hard hyphen** Hyphen required by spelling and always printed, such as in eleven-punch. Contrast with *soft hyphen*.

**hard sector** Wedge-shaped storage division on a floppy disk from time of manufacture. Physically marked by holes punched through the disk to indicate the various sectors. Contrast with *soft sector*.

**hardware** Physical equipment, such as electronic, magnetic, and mechanical devices. Contrast with *software*.

**hardware configuration** Relationships and arrangement of the various pieces of equipment that make up a computer system, including the cables and communications paths that connect them.

**hardware-dependent** See *machine-dependent*.

**hardware description languages (HDL)** Languages and notations that facilitate the documentation, design, simulation, and manufacturing of digital computer systems.

**hardware key** Means to secure software from illegal copying. Plugs into a port or expansion slot on a computer and interacts with a program's antipiracy software to allow the program to run only on that machine.

**hardware resources** CPU time, internal storage space, direct access storage space, and input/output devices, all of which are required to do the work of processing data automatically and efficiently.

**hardware specialist** Person who diagnoses, repairs, and maintains the equipment of a computer system. See *customer engineer*.

**hardwired** Pertaining to the physical connection of two pieces of electronic equipment by means of a cable.

**harness** Group of separate cables bound together.

**HARVARD MARK 1** First electromechanical computer, developed under the direction of Howard Aiken at Harvard University. Also called *ASCC* (Automatic Sequence Controlled Calculator). See *Aiken, Howard Hathaway*.

**HASCI** Acronym for Human Applications Standard Computer Interface, a keyboard layout.

**hash** Visual static on the screen.

**hashing** Key-to-address transformation in which the keys determine the location of the data. Sometimes called hash coding.

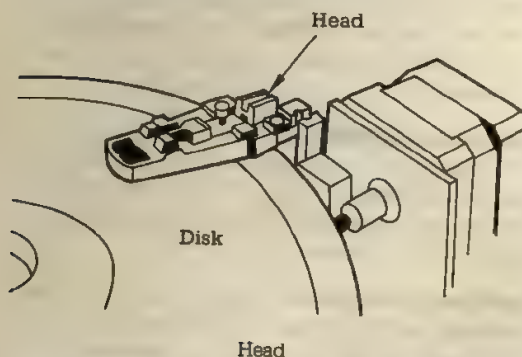
## hash totals

**hash totals** Totals of the numbers of identifying fields. Used in error checking.

**hatching** Shading some portion of a drawing with parallel lines in a single direction. Shading in overlapping directions is *crosshatching*.

**HDBMS** Acronym for *hierarchical database management system*.

**head** (1) Device that reads, records, or erases data on a storage medium, such as a small electromagnet used to read, write, and erase data on a magnetic disk. (2) Special data item that points to the beginning of a list.



**head cleaning device** Material containing a dirt solvent used to clean the read/write head of a floppy disk drive or a tape drive.

**head crash** Collision of the read/write head with the recording surface of a hard disk, resulting in loss of data. Usually caused by contamination of the disk, such as from a tiny particle of smoke or dust or from a fingerprint. Also called *disk crash*.

**header** (1) First part of a message, containing all the necessary information for directing the message to its destination(s). (2) Top margin of a page.

**header card** Card that contains information about the data in cards that follow.

**header record** Record containing constant, common, or identifying information for a group of records that follows.

**head positioning** Placing a read/write head when data is being read or written by a direct-access storage device. Done by moving an *access arm*.

**head slot** Opening in a diskette jacket that exposes the disk surface to read/write heads.

**head switching** Activating the read/write head that is to read or write data when data are being read or written by a direct-access storage device.

**heap** Collection of storage locations that a program can borrow for computations and then return.

**heap sort** See *tree sort*.

**Heath/Zenith** Manufacturer of microcomputer equipment and electronic kits and products.

**hecto** Seldom-used prefix meaning hundred. Contrast with *centi*, one hundredth.

**helical wave guide** Metal tube containing thin glass fibers and wires capable of transmitting thousands of messages over communications lines. See *fiber optics*.

**HELLO** Common *sign-on* message used with terminals in a time-sharing system.

**help** Handy function available on many systems. Supplies the user with additional information on how the system or program works. See *context sensitive help key*.

**henry** Unit of measure of inductance. One henry is the inductance of a circuit in which an electromotive force of 1 volt is produced by a current in the circuit that varies at the rate of 1 ampere per second.

**Hertz** Cycles per second. Abbreviated Hz. See *frequency*.

**heuristic** Descriptive of an exploratory method of attacking a problem, in which the solution is obtained by successive evaluations of progress toward the final results. Pertaining to the use of empirical knowledge to aid in discovery. Contrast with *algorithm*.



**heuristic learning** Discovery method of learning from experience. A way computers can learn from their mistakes by eliminating unsuccessful or unproductive options from their operations. See *artificial intelligence* and *machine learning*.

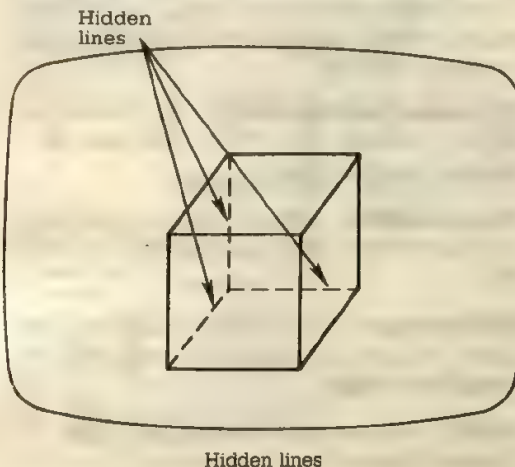
**hex** See *hexadecimal*.

**hexadecimal** Pertaining to a number system with a *radix* of 16. Digits greater than 9 are represented by letters of the alphabet. For example, the binary numeral 1110001011010011 can be represented as hexadecimal E2D3. See *binary-to-hexadecimal conversion*.

**hexadecimal number** A numeral, usually of more than one digit, representing a sum in which the quantity represented by each digit is based on a *radix* of 16. The digits used are 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E, and F.

**hexadecimal point** *Radix point* in a mixed hexadecimal numeral, separating the integer part from the fractional part. In the hexadecimal numeral 3F.6A7, the hexadecimal point is between the digits F and 6.

**hidden line** When displaying a three-dimensional object, any line that would normally be obscured from the viewer's sight by the mass of the object itself, visible as a result of the projection.



**hidden line removal** Process of deleting line segments from a drawing when they would be obscured were the object displayed as a solid three-dimensional figure. Many types of computer graphics software and hardware can remove such hidden lines automatically.

**hidden objects** Distinct graphic entities that would be obscured from view by other entities if they were displayed as solids.

**hidden surface** Entire surface or plane that would be obscured from view if the graphics figure were displayed as a three-dimensional solid.

**hierarchical database management system (HDBMS)** Collection of related programs for loading, accessing, and controlling a database in which the data are organized like an inverted *tree* with a series of nodes connected by branches. Contrast with *network database management system* and *relational database management system*. (See page 138.)

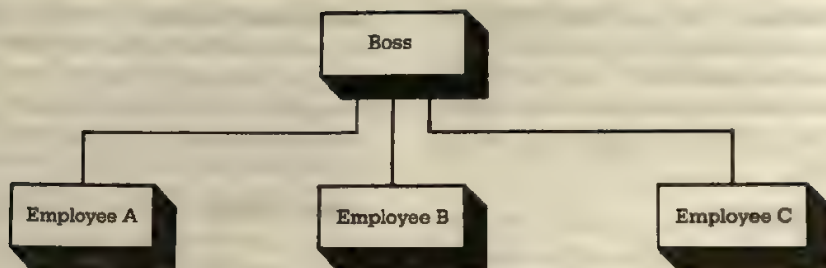
**hierarchical model** Database model in which each object is of a particular hierarchy in a *tree structure*.

**hierarchical network** Computer network in which processing and control functions are performed at several levels by computers specially designed for the functions performed.

**hierarchical structure** In database management systems, the simplest form of file organization, in which records of various levels are related by owning or belonging to each other. Also known as *tree structure*.

**hierarchy** (1) Order in which arithmetic operations within a formula or statement will be executed. See *order of operations*. (2) Arrangement into any graded series.

**hierarchy plus input-process-output (HIPO)** Design and program documentation method that represents functional structure and data flow in a series of three types of diagrams: visual tables of contents that name the program modules and specify their hierar-



Hierarchical database management system

chical relationships; overview diagrams that describe the input, processing, and output for members of the hierarchy; and detailed diagrams that extend the overview diagrams to include more specific input, processing, and output detail with narrative

**high-level language** Any programming language that allows users to write instructions in a familiar notation rather than in a machine code. Each statement in a high-level language corresponds to several machine-code instructions. Contrast with *low-level language*.

```
100 REM *** SIMPLIFIED PAYROLL ***
110 PRINT "ENTER HOURS WORKED";
120 INPUT H
130 PRINT "ENTER HOURLY PAY RATE";
140 INPUT R
150 REM *** COMPUTE WAGE ***
160 LET W = H * R
170 PRINT "WEEKLY WAGE IS $"; W
180 END
```

High-level language

**highlighting** Process of making a display segment stand out by causing blinking, brightening, or underlining, or by reversing the background and the character images, such as dark characters on a light background. Most video displays have software controls to accomplish this on a selective basis. See *brightness*, *image enhancement*, and *reverse video*.

**high-order** Pertaining to the digit or digits of a number that have the greatest weight or significance. In the number 7643215, the high-

order digit is 7. Contrast with *low-order*. See *most significant digit*.

**high-order column** Leftmost column of a punch card field.

**high-persistence phosphor** Phosphor coating used on display monitor screens that holds an image much longer than the coating used on standard TV screens.

**high-punch** Same as *twelve-punch* and *Y-punch*.

**high-resolution** Pertaining to the quality and accuracy of detail that can be represented by a graphics display. *Resolution* quality depends upon the number of basic image-forming units (*pixels*) within a picture image—the greater the number, the higher the resolution. High-resolution pictures, produced by a large number of pixels, are sharper than *low-resolution* pictures.

**high-speed printer (HSP)** Any printer capable of printing from 300 to 3 000 lines per minute. See *line printer*.

**high volatility** High frequency of changes to a file during a given time period. See *volatile file*.

**high storage** Upper address range of a computer. In most machines, it is occupied by the operating system.

**HIPO** Acronym for *Hierarchy plus Input-Process-Output*.



**hi-res graphics** Abbreviation of high-resolution graphics, a smooth and realistic picture on a display screen produced by a large number of pixels. Contrast with *low-res graphics*.

**HIS** Acronym for Hospital Information System.

**histogram** Vertical bar chart often used to graph statistical information. Column widths represent interval ranges; lengths indicate frequencies.

**hit** Successful comparison of two items of data. Compare *match*.

**hobby computer** See *home computer*, *microcomputer*, and *personal computer*.

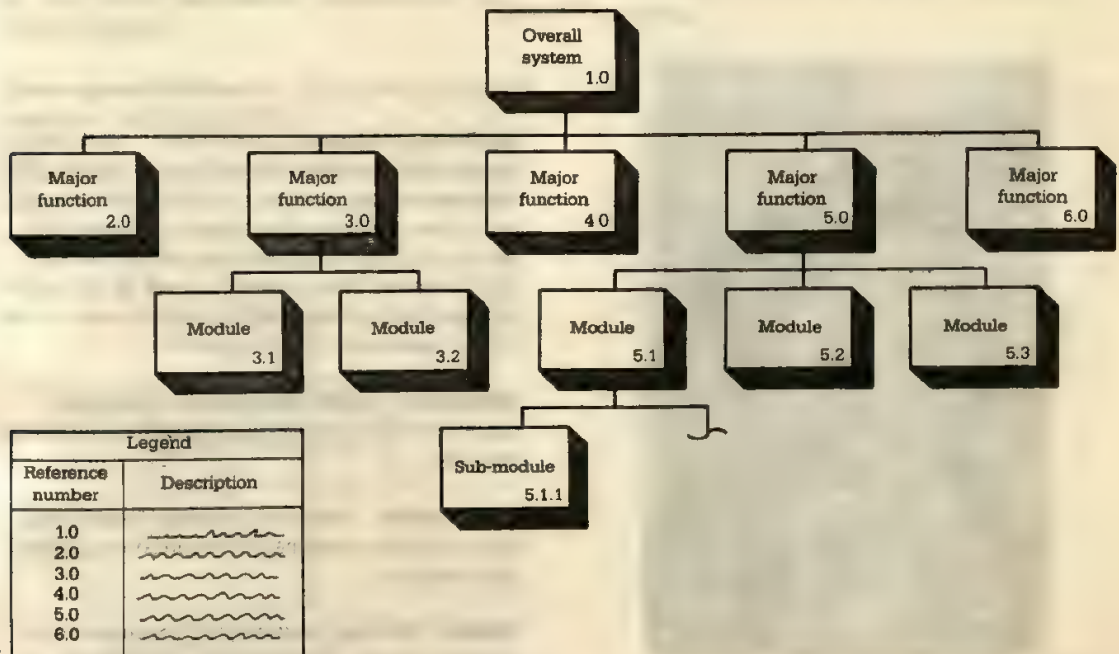
**Hoff, Ted** In 1971, as an engineer with Intel Corporation, Hoff designed the first *microprocessor* (the 4004). The single chip contained 2250 transistors, and all of the components of a full-sized central processing unit. This *micro-*

*chip* caused the computer industry and its suppliers to rethink the future role of the computer. (See page 140.)

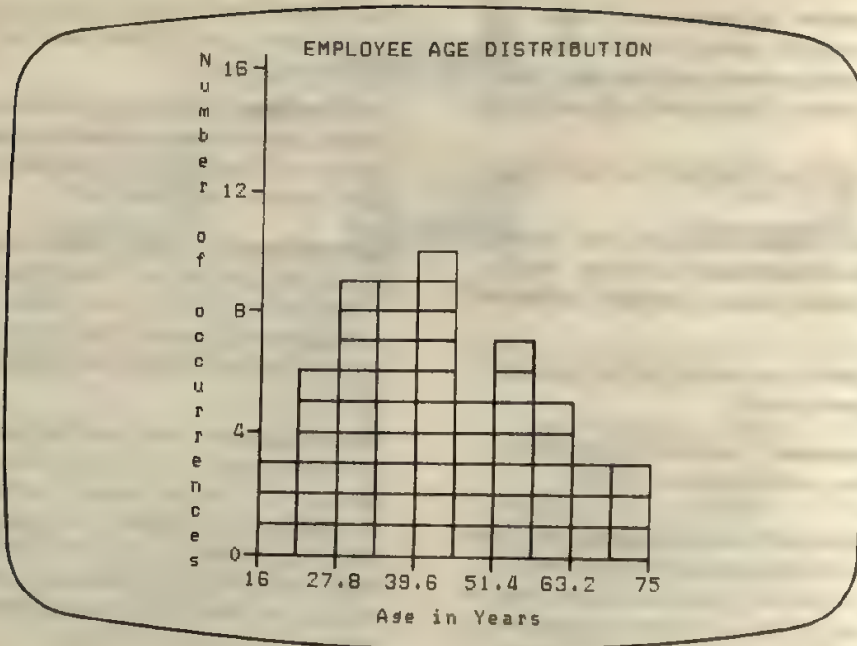
**holding time** In data communications, the length of time a communications channel is in use for each transmission. Includes both message time and operating time.

**Hollerith card** *Punched card* consisting of 80 columns, each of which is divided from top to bottom into 12 punching positions. Can hold 80 characters of alphanumeric data. Contrast with *ninety-column card* and *ninety-six-column card*.

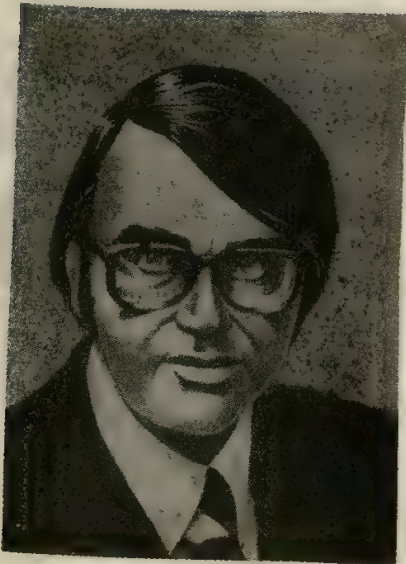
**Hollerith code** Particular code used to represent alphanumeric data on punched cards. Named after Herman Hollerith, originator of punched card tabulating. Each card column holds one character, and each decimal digit, letter, and special character is represented by one, two, or three holes punched into designated row positions of the column.



HIPO chart



Histogram



Ted Hoff

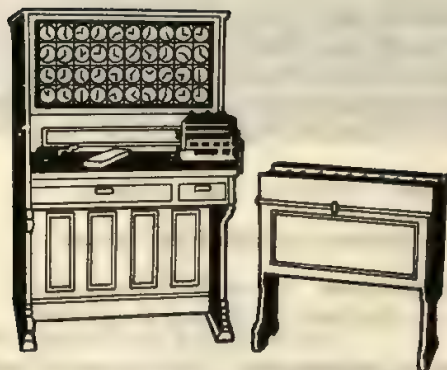
**Hollerith, Herman** (1860–1929) As a statistician and employee of the Census Bureau, he proposed using punched cards in conjunction with electromechanical relays to accomplish simple additions and sortings needed in the 1890 census. The company he set up to manufacture his punched card tabulator became one of the parents of IBM Corporation.

**hologram** Three-dimensional image produced in thin air by lasers interacting with one another.

**holography** Method of storing data by making a multidimensional photograph on a storage medium.

**home** Starting position for the cursor on a terminal screen. Usually in the top left-hand corner.





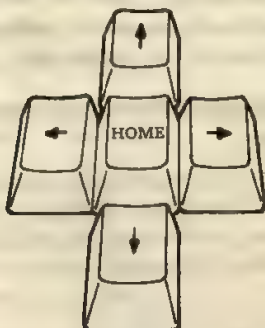
Hollerith's tabulator

**homebrew** Refers to early microcomputer systems, made by hobbyists, that gave rise to the popularity of the personal computer.

**home computer** *Microcomputer* used in the home to play games, control household appliances, aid students with homework, perform business computations, and for a wide variety of other tasks. See *desktop computer* and *personal computer*.

**home-grown software** Programs written by users of a computer system.

**home key** Keyboard function that directs the cursor to its home position, usually in the top left portion of the display screen.



Home key

**home management software** Programs designed for home use to help manage and organize the household, such as check balancing, menu file, and stock portfolio accounting programs.

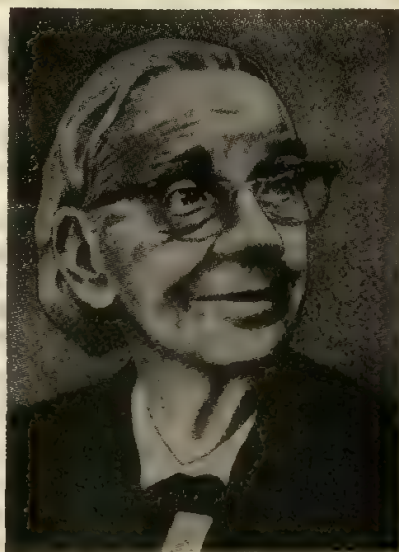
**home record** First record in a chain of records in the chaining method of file organization.

**home row** Row of keys on the keyboard where users rest their fingers between key-strokes.

**homunculus** Infinitely recursive model of the brain. Used in studies of artificial intelligence.

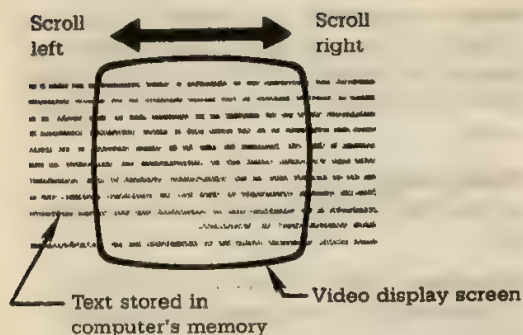
**Honeywell** Large manufacturer of computer equipment

**Hopper, Grace** Mathematician and programmer who developed programs for the MARK 1 and early UNIVAC computers. Later became a pioneer in the field of computer languages, writing the first practical *compiler* program and playing an important role in the development of COBOL.



Grace Hopper

## horizontal scrolling



Horizontal scrolling

**horizontal scrolling** Moving of horizontal blocks of data or text, allowing users to view more data than can fit on the screen at one time.

**host computer** (1) Central processing unit that provides the computing power for remote terminals and peripheral devices connected to it. (2) Computer that is in charge during a telecommunications or local area network session. (3) Central controlling computer in a network of computers. Compare *guest computer*.

**host language** Programming language in which another language is included or embedded.

**hot site** Fully equipped computer center, ready for use in case of emergency.

**hot zone** On some word processors, a user-defined region beginning at the right margin of a page and extending about seven spaces to the left. If a word ends in the hot zone, the system automatically places the next character entered at the beginning of the next line.

**housekeeping** Computer operations that do not directly contribute toward the desired results, but are a necessary part of a program, such as initialization, set-up, and clean-up operations. Sometimes called *bookkeeping*.

**housing** Cabinet or other enclosure.

**HSP** Acronym for *High-Speed Printer*.

**Huffman tree** Tree with minimum values. See *minimal tree* and *optimal merge tree*.

**human engineering** Study concerned with designing products that are easier and more comfortable for humans to use. Also called *ergonomics*.

**human/machine interface** Any boundary at which people interact with machines.

**hybrid computer system** System that uses both analog and digital equipment.

**hybrids** Circuits fabricated by interconnecting smaller circuits of different technologies, mounted on a single substrate. Contrast with *monolithic integrated circuit*.

**hypertape** Magnetic tape unit that uses a cartridge rather than a reel of tape. The cartridge consists of a reel of tape and the take-up reel.

**hysteresis** Any lagging of an effect behind the cause producing it, such as the lagging of the polarization of a magnetic material behind the magnetizing force producing it.

**Hz** Abbreviation for Hertz; cycles per second. See *frequency*.



# I

**IBG** Acronym for *InterBlock Gap*.

**IBI** Acronym for Intergovernmental Bureau of Informatics, an organization consisting of members of the United Nations, UNESCO, or U.N. agencies. Goal is to promote scientific research, computer education and training, and the exchange of information between developed and developing countries. Main focus is to promote *informatics*, particularly in developing countries.

**IBM Corporation** World's largest manufacturer of data processing equipment.

**IBM Personal Computer** Popular micro-computer system manufactured by the IBM Corporation.

**IC** Acronym for *Integrated Circuit*, a complex electronic circuit fabricated on a simple piece of material, usually a silicon chip.

**ICCA** Acronym for *Independent Computer Consultants Association*.

**ICCE** Acronym for *International Council for Computers in Education*.

**ICCP** Acronym for *Institute for Certification of Computer Professionals*.

**ICES** Acronym for *Integrated Civil Engineering System*, a system developed to aid civil engineers in solving engineering problems. Consists of several engineering systems and programming languages.

**icon** Graphic image on a display that represents a message, an object, a file, or a concept. Pictorial abbreviation, such as a sketch of a

trash can to depict the delete function. Used to select a program, document, or command function. (See page 144.)

**ICOT** Acronym for Institute for new generation COmputer Technology, the institute conducting Japan's *fifth generation* research project.

**ICPEM** Acronym for *Independent Computer Peripheral Equipment Manufacturers*.

**identification division** First of four main parts of a *COBOL* program.

**identifier** Symbol whose purpose is to identify, indicate, or name a body of data.

**idle characters** Characters used in data communications to synchronize the transmission. See *synchronous transmission*.

**idle time** Time that a computer system is available for use, but is not in actual operation.

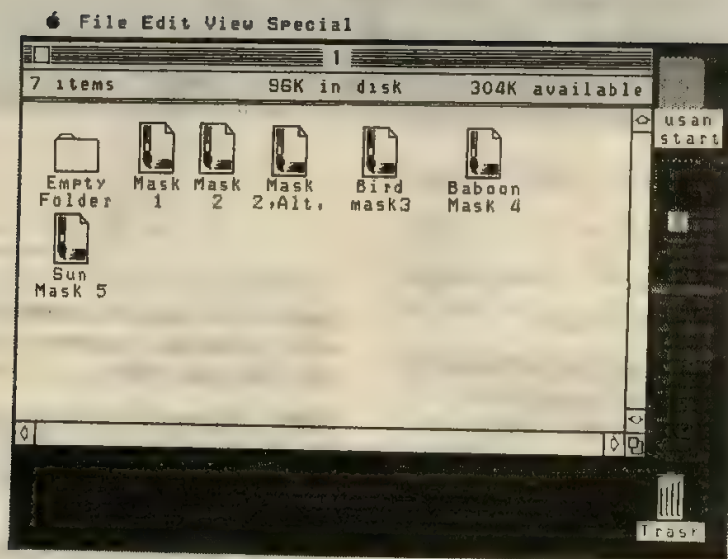
**IDP** Acronym for *Integrated Data Processing*.

**IEEE** Acronym for Institute of Electrical and Electronics Engineers, a professional engineering organization with a strong interest in computer systems and their uses.

**IEEECS** Acronym for *Institute of Electrical and Electronics Engineers Computer Society*.

**IEEE-488** Interface standard mainly used to connect laboratory instruments and other scientific equipment to computers, either for control purposes or to allow the computer to collect data. Type of *parallel interface*.

**IEEE 696/S-100** Identification of a standard,



Icon

developed by the Institute of Electrical and Electronic Engineers. Ensures the compatibility of all computing products designed to this standard.

**IFAC** Acronym for International Federation of Automatic Control, a multinational organization concerned with advancing the science and technology of control.

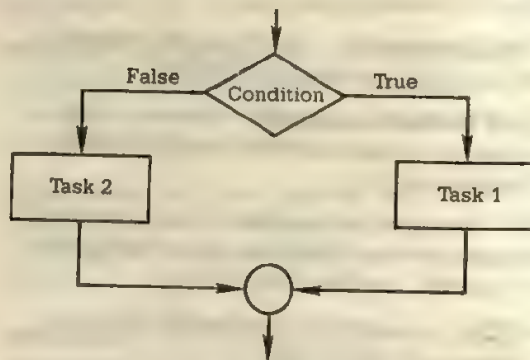
**IFIP** Acronym for *International Federation for Information Processing*.

**if-then-else** One of the three basic building blocks of structured programming.

**IL** Acronym for Integrated Injection Logic, a developing technology expected to be used in future microprocessors and semiconductor memories. IL chips already are used in electronic wristwatches and as control devices for industrial products, automobiles, and computer systems.

**IIR** Acronym for International Institute for Robotics.

**illegal character** Character or combination



If-then-else

of bits not accepted by the computer as a valid or known representation.

**illuminate** To increase the brightness or luminosity of graphical output at a display screen.

**IMACS** Acronym for International Mathematics and Computers Simulation, a professional organization to facilitate exchange of scientific information among specialists, builders, or users interested in analog and hybrid computation methods.



**image** (1) Exact logical duplicate stored in a different medium. If the computer user displays the contents of memory on a display screen, he or she will see an image of memory. (2) In computer graphics, the output form of graphics data, such as a drawn representation of a graphics file.

**image enhancement** Any accentuation of all or part of a graphics image through such techniques as coloring, shading, *highlighting*, *zooming*, *reverse video*, or *blinking*.

**image processing** Method for processing pictorial information by a computer system. Involves inputting graphic information into a computer system, storing it, working with it, and outputting it to an output device. See *vision recognition*.

**immediate access** Ability of a computer to put data in, or remove it from, storage without delay.

**immediate access storage** See *internal storage*.

**immediate address** Pertaining to an instruction whose address part contains the value of an operand rather than its address. It is not an address at all but rather an operand supplied as part of an instruction.

**immediate-mode commands** System and editing commands executed as soon as the carriage control key (ENTER, RETURN) is pressed.

**impact printer** Data printout device that prints by momentary pressure of raised type against paper, using ink or ribbon as a color medium. See *daisy wheel printer*, *line printer*, *thimble printer*. Contrast with *nonimpact printer*.

**impedance** Total opposition (resistance plus reactance) a circuit offers to the flow of alternating current at a given frequency. Measured in ohms.

**implementation** (1) Process of installing a

computer system. Involves choosing the equipment, installing the equipment, training the personnel, and establishing the computing center operating policies. (2) Representation of a programming language on a specific computer system. (3) Act of installing a program.

**import** To read a file created by another program into a database system. Contrast with *export*.

**IMS** Acronym for Information Management System, a *database management system* software package that provides the facilities for storing and retrieving information from hierarchically structured files and databases.

**inactive** Pertaining to a transaction that has been loaded into the computer's memory but has not yet been executed.

**inactive window** Any window not in use.

**incidence matrix** Two-dimensional array that describes the edges in a graph. Also called connection matrix.

**incident light** Light falling on an object. The color of an object is perceived as a function of the wavelengths of incident light reflected or absorbed by it.

**inclusive OR (OR)** Boolean operator that gives a truth table value of true if either or both of the two variables it connects are true. If neither is true, the value is false. Contrast with *exclusive OR*. Compare *NOR*, *NAND*, *AND*, and *logical sum*.

**increment** (1) Amount added to a value or variable. Contrast with *decrement*. (2) Distance between any two adjacent addressable points on a graphics input/output device.

**incremental plotter** Digital *plotter* that outputs graphic data in discrete movements of the plotting head.

**incremental spacing** Synonym for *micro-spacing*.

**indegree** Number of directed edges that point to a node. Contrast with *outdegree*.

**indent** To begin, or move, text a specified number of positions from the left edge or right edge of a paragraph.

**indentation** White space found at the beginning of a line of text; often denotes the beginning of a paragraph.

**Independent Computer Consultants Association (ICCA)** National network of independent computer consultants, founded in 1976. Through the national organization and local chapters, members exchange ideas and become part of a collective voice in the computer consulting industry.

**Independent Computer Peripheral Equipment Manufacturers (ICPEM)**

Organization composed of companies that specialize in manufacturing one or more lines of computer equipment.

**independent consultant** Person trained in the information processing field, who works with businesses and organizations on a temporary basis helping them solve problems. See *consultant*.

**index** (1) Symbol or number used to identify a particular quantity in an array of similar quantities; for example, X(5) is the fifth item in an array of Xs. (2) Table of reference, held in storage in some sequence, that may be accessed to obtain the addresses of other items of data, such as items in a graphics or data file. See *index register*.

**indexed address** Address modified by the content of an index register prior to or during the execution of a computer instruction.

**indexed sequential access method (ISAM)** Means of organizing data on a direct-access device. A directory or index is created to show where the data records are stored. Any desired data record can be retrieved from the device by consulting the index. The index reveals the approximate location of the record or piece of

data on the direct-access device, and the computer searches the area indicated by the index until it locates the desired record or piece of data.

**indexer** Program that generates an index for a document.

**index hole** Hole punched through a floppy disk that can be read by the electro-optical system in the disk drive to locate accurately the beginning of *sector zero* on the disk.

**indexing** Programming technique whereby an instruction can be modified by a factor called an *index*.

**index register** Register whose contents can be added to or subtracted from an address prior to or during the execution of an instruction.

**indicator** Any device that registers a condition in the computer.

**indirect addressing** Using an address that specifies a storage location that contains either a direct address or another indirect address. Also called *multilevel addressing*.

**induce** To produce an electrical charge, current, or voltage by induction. A charge on the *gate* of a *field effect transistor* induces an equal charge in the channel.

**inductance** In a circuit, the property that opposes any change in the existing current. Unit of measure is the *henry*.

**induction** Process by which a body having electric and magnetic properties produces an electrical charge, a voltage, or a magnetic field in an adjacent body, without physical contact.

**industrial data collection device** Input device that can record the time an employee spends on the job. Can be used to determine wages, costs for jobs being done, and so forth.

**industrial robot** Reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices



through variable programmed motions for the performance of a variety of tasks. Unlike other forms of *automation*, robots can be programmed to do a variety of tasks, making them the most versatile of manufacturing tools. Many advantages result from the robot's reprogrammability. Since robots can switch tasks with a minimum of startup and debugging costs, a company is able to maximize its use of a proven design and reduce overall manufacturing costs. Major industries using industrial robots include auto industry, aerospace, electronics, home appliances, consumer goods, and off-road vehicles. Recent developments that give robots added intelligence—such as machine vision, tactile sensing, and mobility—make robots suitable for a wider range of industries. The near future will find robots used increasingly in industries such as textiles, food processing, pharmaceuticals, furniture, construction, and health care. Robots offer substantial gains in manufacturing productivity, particularly when integrated into an automated system. The history of U.S. robot installations indicates that robots increase productivity by 20–30%. Since the majority of robots are applied to existing machinery, companies using robots can accelerate payback on current equipment while reducing the need for new capital investment. For example, it is far more cost-effective to buy robots to make existing stamping presses or machine tools 20–30% more productive than it is to buy one additional piece of machinery at a cost equal to or greater than the robots with less output.

**inequality** Expression of two values not being equal.  $A > B$  and  $B < A$  are two ways of expressing the same inequality.  $A \neq B$  expresses an inequality without identifying its order.

**inference** Process of drawing a conclusion from an initial set of propositions with known truth values.

**inference program** Program that derives a conclusion from given facts.

**infinite loop** Set of instructions that continu-

ously repeat in a program. Loop with no exit condition. Also called *endless loop*.

**infix notation** Common arithmetic notation in which *operators* are embedded within *operands*. Addition of 5 and 3 would be expressed as  $5 + 3$ . Contrast with *prefix notation* and *postfix notation*.

**informal design review** Evaluation of system-designed documentation by selected management, systems analysts, and programmers, prior to the actual coding of program modules, to determine necessary additions, deletions, and modifications to the system design.

**informatics** Word used more or less synonymously with *information technology*.

**information** (1) Meaningful and useful facts that are extracted from data fed to a computer. (2) The meaning assigned to data by known conventions.

**information banks** Large data bases that store information pertaining to specific applications.

**information bits** In telecommunications, those bits that are generated by the data source and do not include error-control bits.

**information explosion** Exponential increase in the growth and diversification of all forms of information. Compare *information revolution*.

**information networks** Interconnection, through telecommunications, of a geographically dispersed group of libraries and information centers for the purpose of sharing their total information resources among more people. (See page 148.)

**information processing** Totality of operations performed by a computer. Involves evaluating, analyzing, and processing data to produce usable information.

**information processing center** Same as *data processing center*.

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Information networks

**information processing curriculum** Same as *data processing curriculum*.

**information providers** Large businesses that supply information to a computer network for a fee, such as *The Source* or *CompuServe*.

**information resource management** System to manage information as a resource like labor, capital, and raw material.

**information retrieval** (1) That branch of computer technology concerned with techniques for storing and searching large quantities of data and making selected data available. (2) Methods used to recover specific information from stored data.

**information revolution** Name given to the present era because of the impact of computer technology on society. Sometimes called the computer revolution.

**information science** Study of how people create, use, and communicate information in all forms.

**information services** Broad-based databases that offer a variety of services, ranging from airline reservation information to stock market quotations. See *CompuServe* and *Source (The)*.

**information storage and retrieval (ISR)** See *information retrieval*.

**information system** Collection of people, procedures, and equipment designed, built, operated, and maintained to collect, record, process, store, retrieve, and display information.

**information technology** Merging of computing and high-speed communications links carrying data, sound, and video.

**information theory** Branch of learning concerned with the likelihood of accurate transmission or communication of messages subject to transmission failure, noise, and distortion. See *operations research*.

**information utility** See *computer utility*.

**inherent error** Computer error that has incorrect initial values caused by uncertainty in measurements, by outright blunders, or by approximating a value by an insufficient number of digits.

**initialize** (1) To preset a variable or counter to proper starting values before commencing a calculation. (2) To format a disk.

**ink jet printer** Output device that prints by spraying a thin stream of ink onto the paper.

**in-line coding** Coding located in the main part of a routine.

**in-line processing** Processing of data in random order, not subject to preliminary editing or sorting.

**in-line subroutine** Subroutine inserted into the main routine as many times as needed.

**input** Introduction of data from an external storage medium into a computer's internal storage unit. Contrast with *output*.

**input area** Area of internal storage reserved for input data. Contrast with *output area*.

**input data** Data to be processed. Often called input. Contrast with *output data*.

**input device** Unit used to get data from the human user into the central processing unit, such as a card reader, *cassette recorder*, *disk*



drive, keyboard terminal, magnetic tape unit, MICR reader, and an acoustic character recognition (voice input) unit. Contrast with *output device*

**input job stream** See *input stream* or *job stream*.

**input media** . Physical substance upon which input data are recorded, such as diskettes, magnetic tape, punched cards, MICR documents, and OCR documents. Compare *output media* and *source media*.

**input/output (I/O)** Pertaining to the techniques, media, and devices used to achieve human/machine communication.

**input/output bound** Pertaining to a situa-

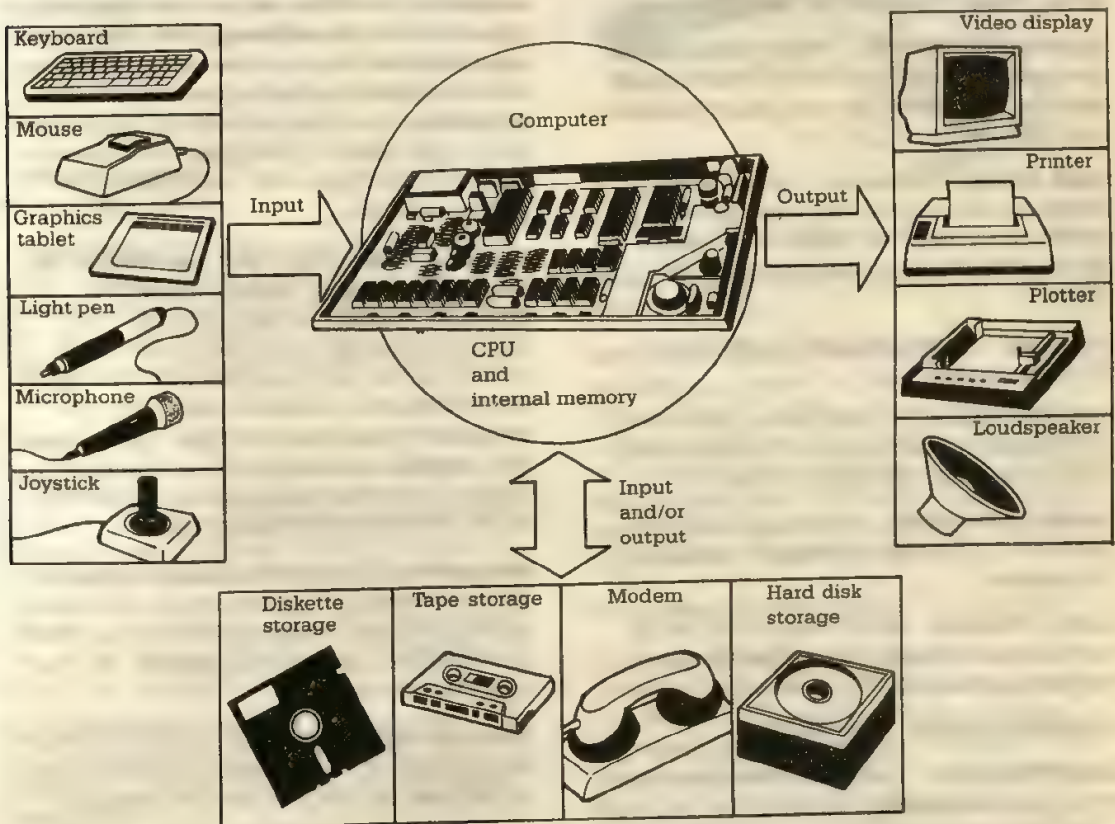
tion in which the central processing unit is slowed down because of I/O operations, which are usually extremely slow in comparison to the internal processing operations of the CPU. Contrast with *processor bound*.

**input/output channel** Channel that transmits input data to, or output data from, a computer. See *multiplexer channel*, *RS-232C*, and *selector channel*.

**input/output control system (IOCS)**

Standard set of routines for initiating and controlling the many detailed aspects of input and output operations

**input/output device** Unit used to get data from the human user into the central process-



Input/output device

## input/output instructions

ing unit, and to transfer data from the computer's internal storage to some storage or output device. See *input device*, *output device*, and *peripheral equipment*.

**input/output instructions** Directions for the transfer of data between peripheral devices and main storage that enable the central processing unit to control the peripheral devices connected to it.

**input/output ports** Sockets on a computer where the peripherals interface. See *peripheral equipment*.

**input/output processor** Auxiliary processor, dedicated to controlling input/output transfers, that frees the central processing unit for non-I/O tasks. Compare *front-end processor*.

**input/output symbol** Parallelogram-shaped *flowcharting symbol* used to indicate an input operation to a procedure or an output operation from a procedure.

**input stream** Sequence of control statements and data submitted to the operating system on an input unit especially activated for that purpose by the operator. Same as *job stream*.

**inputting** Process of entering data into a computer system.

**inquiry** Request for data from storage, such as a request for the number of available airline seats in an airline reservation system.

**inquiry processing** Process of selecting a record from a file and immediately displaying its contents.

**inquiry station** Device from which any inquiry is made. Can be geographically remote from the computer or at the computer console.

**insertion method** See *sifting*.

**insertion point** Position at which text is entered into a document.

**install** To customize elements of a new program so a specific computer system can use it,

such as inserting *protocol* for communicating with the printer into a specific program.

**installation** General term for a particular computing system in the context of the overall function it serves and the individuals who manage it, operate it, apply it to problems, service it, and use the results it produces.

**installation time** Time spent installing, testing, and accepting equipment.

**instant print** Feature of some word processing programs that lets one use the system as a typewriter.

**Institute for Certification of Computer Professionals (ICCP)** Nonprofit organization established in 1973 to test and certify knowledge and skills of computing personnel. A primary objective is to pool the resources of constituent societies so the full attention of the information processing industry can be focused on the vital tasks of development and recognition of qualified personnel. Administers the *CDP* examination.

**Institute of Electrical and Electronics Engineers Computer Society (IEEECS)**

Computer specialty group within the IEEE. One of the leading professional associations in advancing the theory and practice of computer and information processing technology. Publishes three transactions and three magazines and promotes cooperation and exchange of current information among its approximately 62 000 members in all parts of the world.

**instruction** Group of characters, bytes, or bits that defines an operation to be performed by the computer. Usually made up of an *operation code* and one or more *operands*. See *machine instruction*.

**instructional computing** Educational process of teaching individuals the various phases of computer science and data processing.

**instruction code** Same as *operation code*.

**instruction counter** Counter that indicates



the location of the next computer instruction to be interpreted. Same as *program counter*.

**instruction cycle** Time required to process an instruction. This includes fetching the instruction from internal storage, interpreting or decoding the instruction, and executing the instruction. Compare *instruction time*.

**instruction format** Makeup and arrangement of computer instruction.

**instruction register** Hardware register that stores an instruction for execution.

**instruction set** Set of vendor-supplied codes for a particular computer or family of computers. Synonymous with *repertoire*.

**instruction time** Time it takes for an instruction to be retrieved from internal storage by the control unit and interpreted. Often called I-time. Compare *instruction cycle*.

**instruction word** Computer word that contains an instruction.

**instrument** Document designed as a form, report, questionnaire, or guide to be used in a planned systematic data-gathering procedure for the purpose of providing information to the individual, group, or organization initiating the request.

**instrumental input** Data captured by machines and placed directly into the computer.

**instrumentation** Application of devices for the measuring, recording, and/or controlling of physical properties and movements.

**integer** Any member of the set consisting of the *whole numbers* and their negatives. Examples: -24, -1, 0, 1, 2, 13, 128.

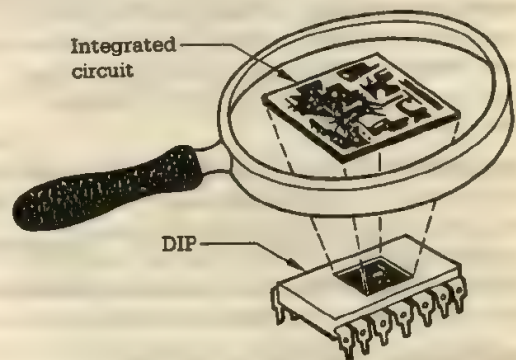
**integer BASIC** Type of BASIC language that can process whole numbers (integers) only: 1 divided by 3 would yield an answer of 0 rather than 0.33333.

**integer variable** Quantity that can be equal to any integer and can take on different values,

usually within a specified range (which may be infinite).

**integrate** Process of putting various components together to form a harmonious computer system.

**integrated circuit (IC)** Miniature circuit on a single semiconductor *chip*. Also, the functionally ready chip after it has been mounted in its package. Contrast with *discrete component*.



Integrated circuit

**integrated computer package** See *integrated programs*.

**integrated data processing (IDP)** Data processing in which the coordination of data acquisition with all other stages of data processing is achieved in a coherent system, such as a business data processing system in which data for sales orders and purchasing are combined to accomplish the functions of scheduling, invoicing, and accounting.

**integrated injection logic** See *I<sup>2</sup>L*. (III).

**integrated programs** Group of programs that may freely exchange data with each other, such as a software package that has a word processor, database manager, electronic spreadsheet, and communications program. Since the information from the electronic spreadsheet may be shared with the database manager and the word processor (and vice

## integration

versa), this software is called integrated. Some integrated programs, for instance, split the screen into windows and allow the operator to work with a word processing document and a spreadsheet simultaneously. See *one-two-three*.

**Integration** Combining diverse elements of hardware and software, often acquired from different vendors, into a unified system.

**Integrity** Preservation of programs or data for their intended purpose. See *data integrity*.

**Intel Corporation** Company that produced the first microprocessor, the 4-bit 4004, and now makes a wide variety of microprocessors used in most of the popular microcomputers. See *Hoff, Ted*.

**Intellect** Trademark of Aruncial Intelligence Corporation for a *natural language* widely used as a *query language*. Can interpret user requests stated in everyday terms and display its interpretation as well as the answer extracted from the database. See *artificial intelligence*.

**Intelligence** See *artificial intelligence*.

**Intelligent language** Programming language that can learn from or be changed by the programmer or user.

**Intelligent terminal** Input/output device in which a number of computer processing characteristics are physically built into, or attached to, the terminal unit. See *point-of-sale terminal* and *local intelligence*. Compare with *smart terminal*. Contrast with *dumb terminal*.

**INTELSAT** International consortium that has launched communications satellites and accounts for most long-distance international communications.

**Intensity** Amount of light in a graphics display device. Level of brightness emitted by a cathode ray tube. On most visual display devices, intensity can be controlled by manipulating a switch.

**Interactive** Yielding an immediate response to input. The user is in direct and continual

communication with the computer system. Denotes two-way communications between a computer system and its operators. An operator can modify or terminate a program and receive feedback from the system for guidance and verification. See *McCarthy, John*.

**Interactive graphics** Any graphics system in which the user and the computer are in active communication.

**Interactive graphics system** Computer graphics system in which workstations are used interactively for computer-aided design, all under full operator control, and possibly, also for text-processing, generation of charts and graphs, computer-aided engineering, and generation of 35 mm slides or animation pictures.

**Interactive processing** Type of real-time processing involving a continuing dialogue between user and computer; the user is allowed to modify data and/or instructions. See *conversational mode* and *transaction-oriented processing*.

**Interactive program** Computer program that permits data to be entered or the flow of the program to be modified during its execution.

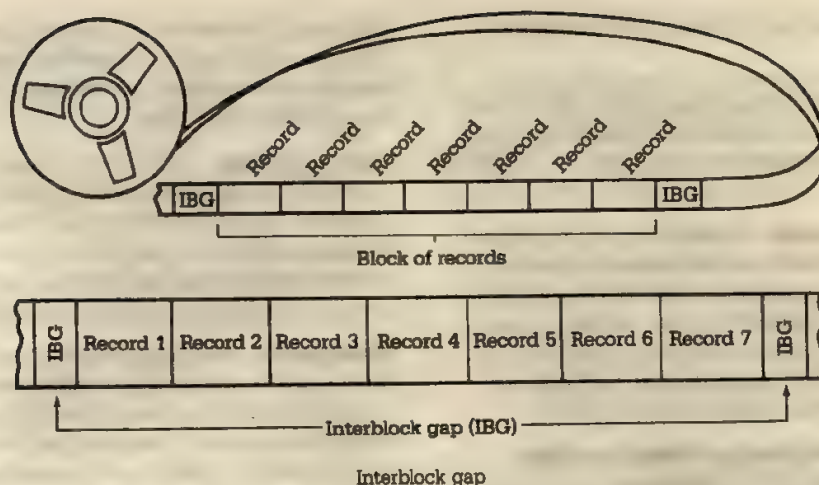
**Interactive query** Operation that allows the immediate retrieval of a specific record or records. Essentially a dialogue in which each user input can elicit a response from the system.

**Interactive system** System in which the human user or device serviced by the computer can communicate directly with the operating program. For human users, this is termed a conversational system.

**Interblock gap (IBG)** Distance on a magnetic tape, disk, or drum between the end of one block of records and the beginning of the next block of records. Contrast with *file gap* and *interrecord gap*.

**Interconnection** Physical and electrical con-





nection of equipment furnished by different vendors.

**interface** Point of meeting between a computer and an external entity, whether an operator, a peripheral device, or a communications medium. May be physical, involving a connector, or logical, involving software. See *Centronics interface*, *IEEE-488*, *RS-232C*, and *sign-on*.

**interface card** Type of expansion board that permits connection of external devices to computers, such as disk interface cards, *serial interface cards*, and *parallel interface cards*.

**interference** Unwanted signals that degrade the quality of wanted signals.

**interlace** To assign successive addresses to physically separated storage locations on a magnetic disk or drum in such a way as to reduce the access time.

**interleaving** Multiprogramming technique in which parts of one program are inserted into another program so that if there are processing delays in one of the programs, parts of the other program can be processed.

**interlock** Protective facility that prevents one device or operation from interfering with another, such as the locking of the switches on the control console to prevent their manual

movement while the computer is executing a program.

**interlude** Preliminary *housekeeping*.

**intermittent error** Error that occurs intermittently, but persistently, and is extremely difficult to reproduce or to debug.

**internal clock** Electronic circuit within the computer system that keeps the time of day.

**internal data representation** Data representation in registers, storage, and other devices inside the computer.

**internal documentation** (1) Insertion of explanatory *comments* and *remarks* into source-language programs. Causes no processing by the computer but acquaints present and future programmers with the functions performed by various parts of the program. (2) Documentation used within a business organization.

**internal memory** Same as *internal storage*.

**internal modem** Modem that plugs directly into computer expansion slots inside the computer. Contrast with *acoustic coupler* and *direct-connect modem*.

**internal report** Report produced by an organization for people inside the organization, usually concerning inventory, quality control,

## internal sort

payroll, and so on. Contrast with *external report*.

**Internal sort** Sequencing of two or more records within the central processing unit. First phase of a *multipass sort* program. See *external sort*.

**Internal storage** Addressable storage directly controlled by the central processing unit. Used to store programs while they are being executed and data while they are being processed. Also called immediate access storage, internal memory, *main storage*, and primary storage. Contrast with *auxiliary storage*.

**International Business Machines Corporation** See *IBM Corporation*.

**International Council for Computers in Education (ICCE)** Professional organization for people interested in instructional computing at the precollege level.

**International Federation for Information Processing (IFIP)** Multinational organization representing professional and educational societies actively engaged in the field of information processing. Holds a meeting, at a different location in the world, every three years. See *World Conference on Computers in Education*.

**Interpolation** Method of finding values between any two known values. In computer

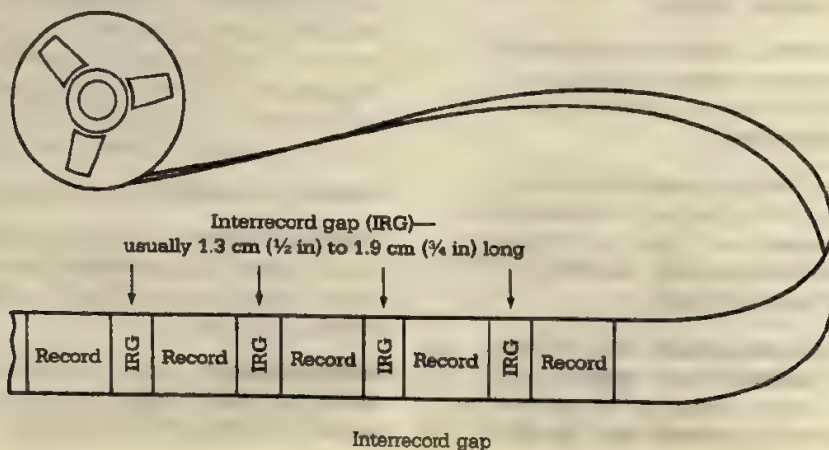
graphics, this process is often applied to creating curves by joining a series of straight line segments or to defining smoothing curves between specified points.

**Interpretation** One-by-one translation of high-level-language program statements into machine-language instructions. When a program is interpreted, each statement is translated and executed before the next statement is processed. Contrast with *compilation*.

**Interpreter** Language translator that converts each source-language statement into machine code and executes it immediately, statement by statement. Program that performs *interpretation*. Contrast with *compiler*.

**Interrecord gap** Space between records on magnetic disk and tape. Used to signal that the end of a record has been reached. Contrast with *file gap* and *interblock gap*.

**Interrupt** Signal that, when activated, causes the hardware to transfer program control to some specific location in internal storage, thus breaking the normal flow of the program being executed. After the interrupt has been processed, program control is again returned to the interrupted program. Can be generated as the result of a program action by an operator activating switches on the computer console or by a peripheral device causing the interrupting





signal. Essential capability for *multiprogramming*. Often called *trapping*.

**interrupt driven** Pertaining to a computer system that makes extensive use of interrupts.

**interruption** Any break in the normal sequence of executing instructions.

**interval timer** Mechanism whereby elapsed time can be monitored by a computer system.

**interview** (1) Fact-gathering method in systems analysis and design. (2) Personal conversation between a job applicant and the person who may offer a job. During an interview, a person has the chance to give the details about his or her skills, education, and past job experience, as well as to find out more about the job and what will be expected of him or her on the job.

**inventory control** Use of a computer system to monitor an inventory.

**inventory management** Daily and periodic bookkeeping commonly associated with inventory control and with forecasting needs for items or groups of items.

**inverse video** Process that shows dark text on a light background display screen. Normally, light text is shown on a dark background. Same as *reverse video*.

**invert** To turn over; reverse. To highlight text or objects by reversing the on-screen display or printout.

**inverted file** File organized so it can be accessed by character rather than by record key.

**inverted structure** File structure that permits fast, spontaneous searching for previously unspecified information. Independent lists are maintained in record keys that are accessible according to the values of specified fields.

**inverter** Circuit in which a binary 1 input produces a binary 0 output, and vice versa.

**inverting circuit** Circuit for changing *direct*

*current* to *alternating current*. Contrast with *adapter*.

**invisible refresh** Scheme that refreshes dynamic memories without disturbing the rest of the system

**I/O** Acronym for *input/output*.

**I/O board** Circuit board that controls the input and output of data between the computer and peripheral devices.

**I/O bound** Term applied to programs that require a large number of input/output operations, resulting in much CPU wait time. Contrast with *compute-bound*.

**I/O channel** Part of the input/output system of a computer. Under the control of I/O commands, the channel transfers blocks of data between internal storage and peripheral equipment.

**IOCS** Acronym for *Input/Output Control System*.

**I/O port** Connection to a central processing unit that provides for data paths between the CPU and peripheral devices, such as display terminals, typewriters, line printers, and magnetic disk units.

**I/O processor** Circuit board or chip used only to handle input/output operations between the computer and peripherals

**IPL** Acronym for *Information Processing Language*. See *list processing languages*.

**IPL-V** Acronym for *Information Processing Language Five*, a *list processing language* primarily used for working with *heuristic-type* problems.

**IRG** Acronym for *InterRecord Gap*.

**IRM** Acronym for *Information Resources Manager*, the person responsible for operating a company's main computer and for monitoring the numerous employees using it.

**ISAM** Acronym for *Indexed Sequential Accessed Method*.

**ISO** Acronym for International Standards Organization, an international agency responsible for developing standards for information exchange. Has a function similar to that of *ANSI* in the United States.

**isolation** (1) In a computer security system, the compartmentalization of information so access to it is on a "need to know" basis. (2) State of being separated or set apart from others.

**ISR** Acronym for Information Storage and Retrieval. See *information retrieval*.

**item** (1) Group of related characters treated

as a unit. A record is a group of related items, and a file is a group of related records. (2) Selection within a menu.

**iterate** To repeat automatically, under program control, the same series of processing steps until a predetermined stop or branch condition is reached. See *loop* and *Newton-Raphson*.

**iterative** Repetitive. Often used when each succeeding iteration, or repetition, of a procedure comes closer to a desired result.

**I-time** See *instruction time*.



# J

**jack** Connecting device to which a wire or wires of a circuit may be attached and that is arranged for the insertion of a *plug*. Also called socket. See *female connector*.

**jacket** Stiff paper container that holds a *diskette*.

**Jacquard, Joseph Marie** (1752–1834) Built a weaving machine (*Jacquard loom*) that used a line of punched cards to control automatically the patterns woven.

**Jacquard loom** Weaving machine invented near the beginning of the 19th century by Joseph Marie Jacquard. Punched cards controlled



Jacquard loom

the movements of the shuttles to produce tapestries of complicated design.

**jaggies** In a computer graphics display, the stairstepped or saw-toothed effect of diagonals, circles, and curves.

**JCL** Acronym for *Job Control Language*.

**JES** Acronym for Job Entry System, a portion of the *operating system* that accepts and schedules jobs for execution.

**jitter** Brief instability of a signal, applied particularly to signals on a video display.

**job** Collection of specified tasks constituting a unit of work for a computer, such as a program or related group of programs used as a unit.

**job control language (JCL)** Language that defines a job and the resources it requires from the computer system, including constraints on the job, such as time limits. The language is more often interpreted than compiled.

**job control statement** One statement, written in a job control language, that defines one aspect of a job.

**job number** Identification number assigned to a job.

**job queue** Set of programs and data currently making its way through the computer. In most operating systems, each job is brought into the queue and is processed (given control of the computer) when it is the "oldest" job within its own priority. An exception to this is a job of higher priority that has not yet obtained sufficient resources to be processed.

job scheduler

**job scheduler** Person who aids computer operators in the running of a large computer installation.

**Jobs, Steve** Co-founder of Apple Computer, Inc., developer of several microcomputer systems including the Apple IIc, Apple IIe, and Macintosh. See *Wozniak, Stephen*.



Steve Jobs

**job stream** Input to the operating system. May consist of one or more jobs. Same as *input stream*.

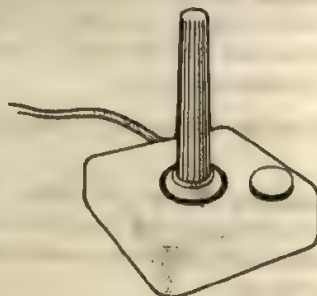
**job-to-job transition** Process of locating a program and the files associated with the program and of preparing the computer for the execution of a particular job.

**job turnaround** Elapsed time from when a job is given to the computer system until its printed output reaches the person who submitted the job.

**Josephson junction** Potentially high-capacity data storage system based upon the properties of supercold circuits. This *cryoelectronic storage* is in the research stage.

**JOVIAL** Acronym for Jules' Own Version of the International Algorithmic Language, a programming language used primarily for working with scientific and command and control problems. Has wide usage in systems implemented by the U.S. Air Force.

**joystick** Electromechanical lever that, when manipulated, moves the cursor. Primarily used to play video games, it is attached to the computer by a cable.



Joystick

**joystick** Joystick-type input device that can be moved in any of eight directions: up, down, right, left, and in four diagonal directions.

**JUG** Acronym for Joint Users Group, an organization of digital computer *user groups*.

**Julian number** Form of calendar representation within a computer system. The Julian date indicates the year and the number of elapsed days in the year; for example, 86-029 was January 29, 1986, the 29th day of 1986.

**jump** Departure from the normal sequence of executing instructions in a computer. Synonymous with *branch* and *transfer*. See *conditional transfer*, *unconditional transfer*, and *trap*.

**junction** That part of a diode or transistor where two opposite types of semiconductor material meet.

**junk** Garbled data received over a communications line. If proper communication is not established with a remote system, random,



meaningless characters (junk) may appear on the screen. See *garbage*.

**justification** (1) Act of adjusting, arranging, or shifting digits to the left or right to make them fit a prescribed pattern. (2) Alignment of text margins on both right and left sides. Justified text is both flush left and flush right. Contrast with *ragged left* and *ragged right*.

**justify** To align the characters in a field. For example, to right justify, the last character (the *least significant digit*) is written in the last, or rightmost, character position in the field. Alphabetical lists are commonly left justified. See *justification*.

# K

**K** (1) Abbreviation for kilo, or 1000 in decimal notation. For example, "100K ch/s means a reading speed of 100 000 characters per second." (2) Loosely, when referring to storage capacity,  $2^{10}$ ; in decimal notation, 1024. The expression 8K represents 8192 ( $8 \times 1024$ ).

**Kansas City Standard** Low-speed cassette storage format.

**Karnaugh map** Two-dimensional plot of a truth table.

**kb** Abbreviation for *kilobyte*.

**kc** One thousand characters per second. Used to express the rate of *data transfer operations*.

**keep-out areas** User-specified areas on a printed circuit board layout where components or circuit paths must not be located and which therefore must be avoided by CAD/CAM automatic placement and routing routines.

**Kelvin** Unit of temperature measurement of the SI metric system, for normal use expressed in degrees Celsius.

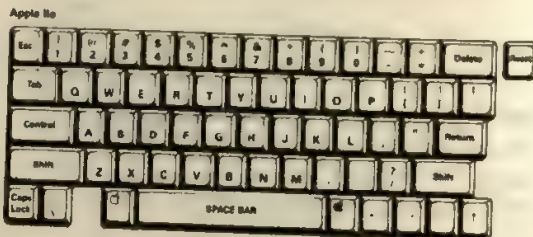
**Kemeny, John** In 1964, with Thomas Kurtz, at Dartmouth College, designed the computer language *BASIC*, an easy-to-learn, easy-to-use algebraic programming language. Also developed the Dartmouth Time-Sharing System. See *Kurtz, Thomas*.

**kernel** Set of programs in an *operating system* that implement the most *primitive* of that system's functions.

**Kerning** Reduction of excess white space between specific letter pairs, such as the ligature *fi*.

**key** (1) *Control field* or fields that identify a record. See *primary key*. (2) Field that determines the position of a record in a sorted sequence. See *major sort key* and *minor sort key*. (3) Lever on a manually operated machine, such as a typewriter or visual display keyboard. (4) To enter data into a system by means of a keyboard.

**keyboard** Input device used to key programs and data into the computer's storage. See *Dvorak keyboard*, *Maltron keyboard*, and *QWERTY keyboard*.



Keyboard

**keyboarding** Process of entering programs and data onto input media or directly into the computer by typing on a keyboard, such as using the keyboard of a word processor or computer terminal.

**keyboard terminal** Typewriterlike keyboard that allows data to be entered into a computer system.



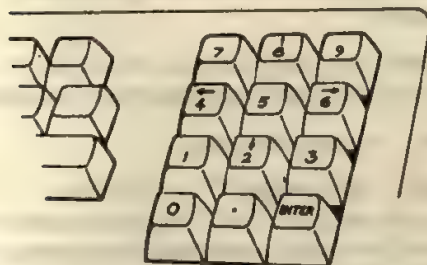
**keyboard-to-disk system** Data entry system in which data can be entered directly onto a disk by typing the data at a keyboard.

**keyboard-to-tape system** Data entry system in which data can be entered directly onto a tape by typing the data at a keyboard.

**key bounce** Characteristic of some poorly designed keyboards where a character registers twice for each time the user presses the key.

**key data entry device** Equipment, including keypunch machines, key-to-disk units, and key-to-tape units, used to prepare data so computer equipment can accept it.

**keypad** Input device that uses a set of decimal digit keys (0-9) and two special function keys. Used as a separate device or sometimes located to the right of a standard QWERTY keyboard—one result of *ergonomics*.



Keypad

**keypunch** Keyboard-operated device used to punch holes in punch cards to represent data to be input to a computer by a *card reader*. Compare *card punch*.

**keypunching** Process by which original data are recorded on punch cards. The operator reads source documents and, by depressing keys on a keypunch machine, converts source-document information into punched holes.

**key stations** Terminals used for data input on a multiuser system.

**keystroke** Action of pressing a single key or a combination of keys on a keyboard. Speed in many data entry jobs is measured in *key-strokes per minute*. See *keyboarding*.

**key switch** Switch part of the input key on a keyboard.

**key-to-address** See *hashing*.

**key-to-disk unit** Keyboard unit used to store data directly on a flexible disk (diskette). (See *page 162*.)

**key-to-tape unit** Keyboard unit used to store data directly on magnetic tape.

**key verification** See *card verification*.

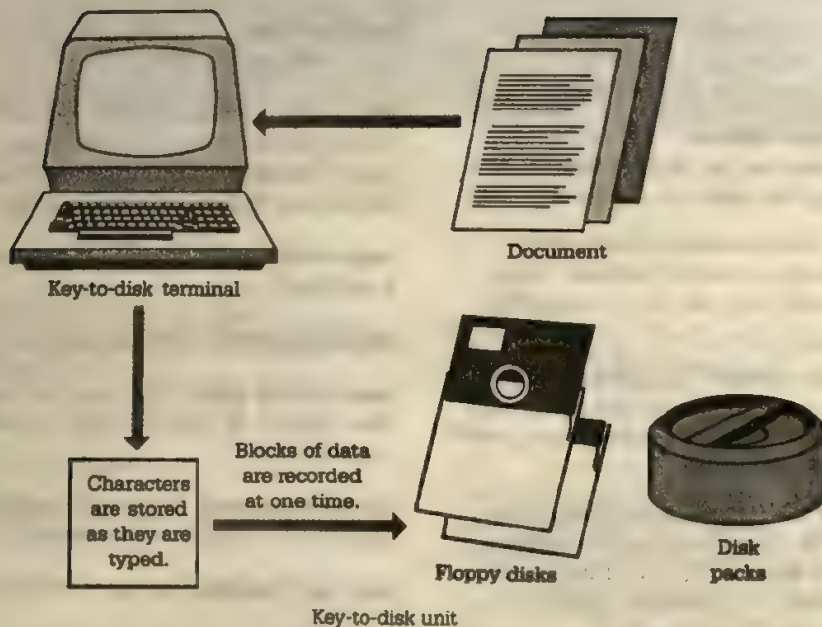
**key-verify** Use of the punch card machine known as a *verifier*, which has a keyboard, to make sure the information supposed to be punched in a punch card has actually been properly punched. The machine indicates when the punched hole and the depressed key disagree.

**keyword-** (1) One of the significant and informative words in a title or document that describe the content of that document. (2) Primary element in a programming-language statement, such as LET, GOTO, and INPUT in the BASIC programming language. (3) Set of words that have special meaning to a computer program. For example, CAT is a command that directs the operating system to produce a CAT-ALOG of a disk. See *reserved words*.

**key-word-in-context** See *KWIC*.

**kHz** Abbreviation for *kilohertz*.

**Kilby, Jack** Inventor with Texas Instruments who introduced the integrated circuit in 1958. He also developed an early hand-held electronic calculator. See *Noyce, Robert*.



Jack Kilby

**kill** (1) To delete. To terminate a process before it reaches its natural conclusion. (2) Method of erasing information.

**kilo** Metric prefix meaning one thousand, or  $10^3$ . Abbreviated K. Contrast with *milli*, one thousandth.

**kilobaud** One thousand bits per second. Used to measure data communications speeds.

**kilobit** One thousand bits.

**kilobyte** Specifically,  $2^{10}$ , or 1024 bytes. Commonly thought of as 1 000. Abbreviated K and used as a suffix when describing memory size. Thus, 24K really means a  $24 \times 1024 = 24,576$ -byte memory system. Sometimes abbreviated kb. Compare *megabyte*, *gigabyte*, and *terabyte*.

**kilocycle** One thousand cycles. Formerly, one thousand cycles per second, now termed kilohertz.

**kilohertz** One thousand cycles per second. Used to measure data transmission frequencies.

**kilomegacycle** One billion cycles per second.



**kinematics** Computer-aided engineering process for plotting or animating the motion of parts in a machine or a structure under design on the system.

**KIPS** Acronym for Knowledge Information Processing System, the name given to the proposed *fifth generation computers*.

**kludge** Makeshift. Pertaining to a collection of mismatched components that have been assembled into a system.

**knowledge acquisition** See *Machine learning*.

**knowledge base** Database of knowledge about a particular subject. Contains facts, inferences, and procedures needed for problem solution.

**knowledge engineering** Engineering discipline whereby knowledge is integrated into computer systems to solve complex problems normally requiring a high level of human expertise

**knowledge industries** Industries that perform data processing and provide information products and services.

**knowledge representation** Structure and organization of the information required for a problem.

**knowledge work** Occupations where the primary activities involve receiving, processing, and transmitting information.

**KSR** Acronym for Keyboard Send/Receive, a teletypewriter unit with keyboard and printer.

**Kurtz, Thomas** In 1964, with John Kemeny, at Dartmouth College, designed the computer language *BASIC*, an easy-to-learn, easy-to-use algebraic programming language. See *Kemeny, John*.

**KWIC** Acronym for Key-Word-In-Context, a method of indexing information by preselected words or phrases that takes into consideration the context in which the words are used.

# L

**label** Identifier or name used in a computer program to identify or describe an instruction, statement, message, data value, record, item, or file. Same as *name*.

**lag** Relative difference between two events, mechanisms, or states.

**LAN** Acronym for *Local Area Network*, hardware and software systems that undertake the job of interdevice communications within limited distances.

**land** Area of a printed circuit board available for mounting electronic components.

**language** Set of rules, representations, and conventions used to convey information. See *programming language*.

**language processor** Program that translates human-written source language programs into a form that can be executed on a computer. There are three general types of language processors: *assembler*, *compiler*, and *interpreter*.

**language prompt** Same as *prompt*.

**language statement** Statement coded by a user of a computing system that conveys information to a processing program, such as a language translator program, service program, or control program. May signify that an operation be performed or may simply contain data to be passed to the processing program.

**language subset** Part of a language that can be used independently of the rest of the language.

**language translation** Process of changing

information from one language to another, such as from BASIC to FORTRAN or from FORTRAN to Pascal.

**language translator program** Program that transforms statements from one language to another without significantly changing their meaning, such as a *compiler* or *assembler*.

**lap computer** Notebook- or briefcase-size *portable computer*, usually weighing less than 10 pounds.

**large scale integration (LSI)** Process of placing a large number (usually over 100) of integrated circuits on one silicon chip. See *very large scale integration*. Compare *small scale integration*, *medium scale integration*, and *super large scale integration*.

**laser** Acronym for Light Amplification by Stimulated Emission of Radiation, the technology that uses the principle of amplification of electromagnetic waves by simulated emission of radiation and operates in the infrared, visible, or ultraviolet region.

**laser printer** *Nonimpact printer* that places images on a rotating drum by using a laser beam. The drum picks up a toner powder on the laser-exposed areas. These areas on the drum are pressed and fused into the paper, forming the characters.

**laser storage** Auxiliary storage device using laser technology to encode data onto a metallic surface.

**last in-first out** See *LIFO*.

**last in-last out** See *LIFO*.



**latency** Rotational delay in reading or writing a record to a direct access auxiliary storage device, such as a disk or drum.

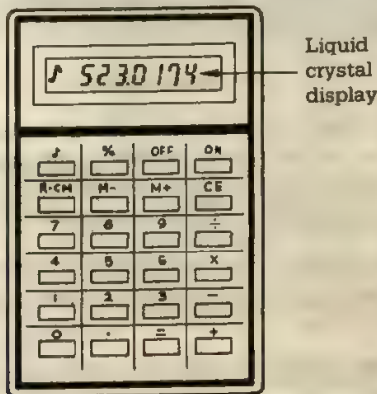
**layer** (1) Subset of the data in a graphics file given a logical association. (2) Third dimension in a 3-D array.

**layering** Logical concept that associates subgroups of graphic data within a single drawing. Allows a user to view only those parts of a drawing being worked on and reduces the confusion that might result from viewing all parts of a very complex file.

**layout** Overall design or plan, such as system flowcharts, schematics, diagrams, format for printer output, format for card columns, and makeup of a document (book).

**layout sheet** Grid paper designed to map the display screen for purposes of program planning. Text and graphics can be sketched in terms of rows and columns or the graphics X-Y coordinates.

**LCD** Acronym for Liquid Crystal Display, a way to make letters and numbers appear by reflecting light on a special crystalline substance. Features high visibility in high illumination levels but no visibility in low illumination levels. Because of its thin profile, LCD technology is often used in pocket calculators,



LCD

pocket computers, briefcase computers, keyboards, watches, and other devices.

**LDL** Acronym for Language Description Language, a metalanguage—a language that describes a language.

**leader** Blank section of tape at the beginning of a reel of paper tape or magnetic tape.

**leading** Vertical distance between the maximum lower limit of a line of type and the maximum upper limit of the next line.

**leading edge** (1) Edge of a punched card that first enters the card reader. Contrast with *trailing edge*. (2) In optical scanning, the edge of the document or page that enters the read position first. (3) Buzz word implying technological leadership: "on the leading edge of technology."

**leaf** Terminal *node* of a *tree diagram*. See *root*.

**lease** Method of acquiring the use of a computer system. A lease contract requires no financing and is less expensive than renting the system.

**leased lines** Dedicated communications channels leased from a common carrier. Also called *nonswitched lines* and *tie lines*. See *dedicated lines*. Contrast with *switched lines*.

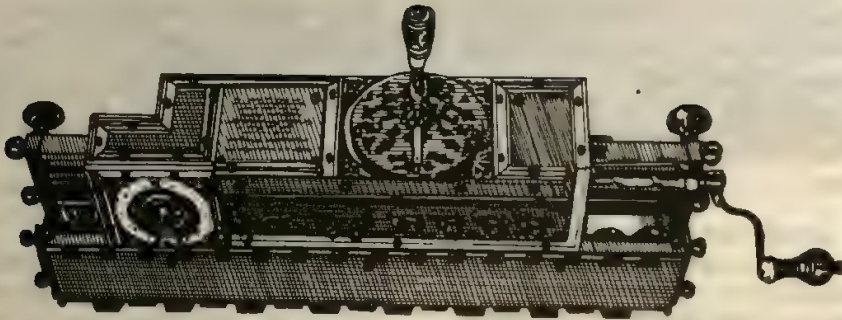
**leasing companies** Companies that specialize in leasing computer equipment, which they purchase from a computer manufacturer.

**least significant digit (LSD)** That digit of a number that has the least weight or significance. In the number 58371, the least significant digit is 1. See *justify* and *low-order*.

**LED** Acronym for Light-Emitting Diode, a commonly used alphanumeric display unit that glows when supplied with a specified voltage.

**left justify** See *justify*.

**Leibniz, Gottfried von** (1646–1716) German mathematician who invented a calculating ma-



Leibniz's calculator

chine called a "stepped reckoner" (1672) that could add, subtract, and multiply.

**Leibniz's calculator** Calculating machine designed by Gottfried von Leibniz. Performed addition and subtraction in the same manner as *Pascal's calculator*; however, additional gears were included in the machine that enabled it to multiply directly.

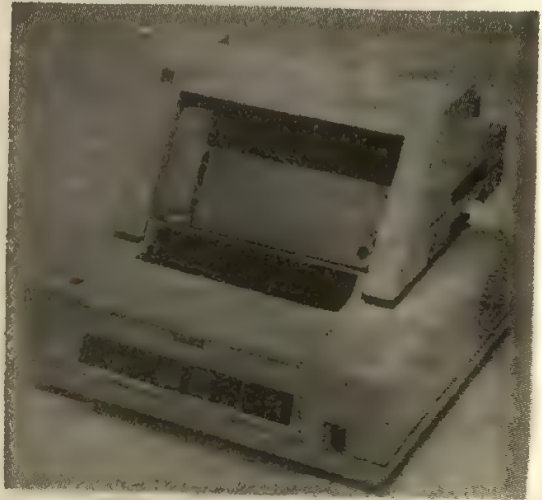
**length** Number of characters, bytes, or bits in a computer word. A variable word is made up of several characters, ending with a special end character. A fixed word is composed of the same number of bits, bytes, or characters in each word. See *fixed word length* and *variable word length*.

**less than** Relationship of an inequality between two values. The symbol is  $<$ , with the point toward the smaller number.  $3 < 8$  means 3 is less than 8. Commonly used in *comparison* to determine alternative processing. Contrast with *greater than*.

**letter quality** Pertaining to printed copy of the highest quality, comparable to that obtained on a good typewriter. See *correspondence quality*. Contrast with *draft quality*.

**letter-quality printer** Printer that produces clear, sharp characters on ordinary paper. The most common type uses a daisy-shaped wheel with characters on the ends of flexible stalks. As the wheel spins at high speed and the print head moves across the page, a hammer strikes the appropriate letters, producing text of higher

quality than even a fine typewriter. Some printers of this type use *thimble* or golf-ball print mechanisms instead of a daisy wheel.



Letter-quality printer

**letter shift** Keyboard key, or the code generated by the key, that signifies that the characters that follow are to be read as letters until a *figure shift* appears in the message.

**level** Degree of subordination in a hierarchy. Measure of the distance from a *node* to the root of a tree.

**lexicon** Any language with definitions for all terms.

**LF** Acronym for *Line Feed*.



**librarian** (1) Person responsible for an organization's library of technical documentation, including manuals used by programmers, operators, and other employees. (2) Person responsible for the safekeeping of all computer files, such as disk packs and magnetic tapes. Also called *custodian*, *file librarian*, *software librarian*, and *tape librarian*.

**library** Published collection of programs, routines, and subroutines available to every user of the computer. Same as *program library*. Compare *disk library* and *tape library*.

**library automation** Application of computers and other technology to library operations and services.

**library manager** Program that maintains the programs stored in an operating system.

**library routine** Tested routine maintained in a *program library*.

**license contract** Piece of paper that authorizes the purchaser of a software product to run the product on his or her computer.

**life cycle** Course of a program or system from the inception of the original idea through development, implementation, and maintenance, until it is either replaced or no longer useful.

**LIFO** Acronym for Last In-First Out, the way most microprocessor program stacks operate. The last data or instruction word placed on the stack is the first to be retrieved. Same as *FILO*. See *push down stack*. Contrast with *FIFO*.

**light-emitting diode** See *LED*

**light guide** Channel designed for the transmission of light, such as a cable of *optical fibers*. See *fiber optics*.

**lightness** Amount of light or dark present in a particular color.

**light pen** Electronic device that resembles a pen and can be used to write or sketch on the screen of a cathode ray tube to provide input

to the computer. Tool for display terminal operators, connected to the computer by a cable. See *digitizer*, *joystick*, and *mouse*.



Light pen

**LILO** Acronym for Last In-Last Out, a method of storing and retrieving items from a list, table, or stack, such that the last item placed on the stack is the last to be retrieved. Same as *FIFO*. Contrast with *FILO*.

**limit check** Input control technique that tests the value of a data field to determine whether values fall within set limits or a given range.

**limiting operation** That operation in a system that has the smallest capacity or slowest speed. Since the capacity of a total system with no alternative routing can be no greater than the operation with the least capacity, the total system can be effectively scheduled by simply scheduling the limiting operation. Synonymous with *bottleneck*. See *bound*.

**line** (1) In computer graphics, a particular set of points. Lines in geometry extend in two directions without end. In mathematics, unless otherwise stated, lines are always thought to be straight. (2) In most programming languages, a line begins with an identifying number and contains one or more statements.

## linear IC

Sometimes a statement requires more than one line. (3) In data communications, any type of *channel*, but especially telephone lines.

**linear IC** Analog *integrated circuit*, as opposed to a digital integrated circuit.

**linear list** See *sequential list*.

**linear programming (LP)** Technique for finding an optimum combination when there may be no single best one. Could be used to solve the problem: What combination of foods would give the most calories and best nutrition for the least money? A computer is often used because such problems would take too long to solve by hand. See *operations research*. Contrast with *nonlinear programming*.

**linear search** Search that begins with the first element and compares until a matching key is found or the end of the list is reached.

**linear structure** (1) In database management systems, a mode of file organization in which each primary record can own only one secondary record. The latter functions as an overflow record for the primary record. (2) Sequential arrangement of data records.

**line-at-a-time printer** Same as *line printer*.

**line balancing** Management technique used in production environments wherein tasks are assigned to computer graphics workstations in equal proportions, thus raising efficiency.

**line chart** Method of charting business data.

**line circuit** Physical circuit path, such as a data communications line.

**line drawing** Drawing where an object's image is represented by a solid-line outline of the surface.

**line feed (LF)** Operation that advances printer paper by one line. See *form feed*.

**line filter** Device used to correct electromagnetic interference that comes in over the power line.

**line generator** Hardware or software system that produces lines on a computer graphics system in random configurations.

**line height** Height of one line of type. Measured by the number of lines per vertical inch.

**line number** In programming languages such as BASIC, a number that begins a line of the source program for purposes of identification; a numerical label. Also called *statement label*.

**line of code** Statement in a programming language usually occupying one line of code.

**line plot** Graph with displayed data points, and straight lines connecting the points.

**line printer** Peripheral device that prints output one line at a time. See *electrostatic printer*. Contrast with *character printer*.

**line printer controller** Device that provides character print buffers and automatic control and timing for a specific printer.

**line printing** Printing of an entire line of characters as a unit.

**line segment** Portion of a longer line defined by its two end points.

**line speed** Maximum rate at which signals may be transmitted over a given channel, usually in baud, or bits per second.

**lines per minute (LPM)** Usually used to describe the speed of a line printer.

**line style** In computer graphics, the method of representing a line in a graphics system, such as with dashes, solid lines, or dots.

**line surge** Sudden, high-voltage condition. Short surges of high voltage can cause misregistration, false logic, lost data, and even destruction of delicate circuits in computers, data entry terminals, and data communications equipment. These *spikes* can be a result of inductive load switching of transformers and other types of equipment—even from lightning



Line Number

```

100 PRINT ``CONVERT FEET TO METERS``
110 PRINT
120 PRINT ``HOW MANY FEET``
130 INPUT F
140 IF F = 0 THEN 190
150 Y = F/3
160 M = Y*0.9144
170 PRINT F; ``FEET EQUALS``;M;``METERS``
180 GO TO 110
190 END

```

Line number



Line printer

and static. Equipment can be protected from voltage surges by using *surge protectors*.

**line voltage** AC voltage that comes out of a standard wall socket.

**line width** Actual, physical thickness of a line in a graphics system.

**link** In data communications, a physical connection between one location and another whose function is to transmit data, including satellite links. See *communications channel*.

**linkage** Coding that connects two separately coded routines, such as coding that links a subroutine to the program with which it is to be used. See *calling sequence*.

**linker** Program that links other programs or sections of programs. Combines separate program modules into one executable program.

**linking loader** Executive program that connects different program segments so that they may be run in the computer as one unit. Useful piece of software that makes subtasks easily available to a main task.

**link register** Register of one bit that acts as an extension of the *accumulator* during rotation or carry operations. Also called *carry register*.

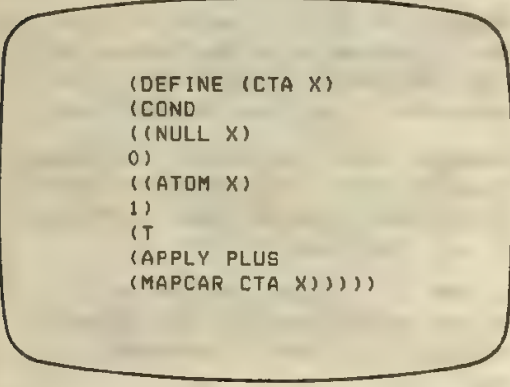
**links** Data communications channels in a computer network.

**LIPS** Acronym for Logical Inferences Per Second, the unit of measurement of speed for *fifth generation computers*.

**liquid crystal display (LCD)** Visual display made of two sheets of polarizing material sandwiched together with a nematic liquid crystal solution between them. Images are produced when electric currents cause the liquid crystals to align so light cannot shine through. See *LCD*.

**Lisa** Business-oriented microcomputer system manufactured by Apple Computer, Inc.

**LISP** Acronym for LISt Processing, a high-level programming language primarily designed to process data consisting of lists. Especially suited for text manipulation and analysis. Programming language of choice for *artificial intelligence* in the United States. See *list processing languages* and *McCarthy, John*.



```
(DEFINE (CTA X)
(COND
((NULL X)
0)
((ATOM X)
1)
(T
(APPLY PLUS
(MAPCAR CTA X))))))
```

LISP

**LISP machine** Computer designed specifically for *artificial intelligence* applications and especially designed to run LISP software.

**list** (1) Organization of data, using indexes and pointers to allow for nonsequential retrieval. (2) Ordered set of items. (3) To print every relevant item of input data. (4) Command to print program statements; for example, the LIST command in the BASIC language will

cause the system to print a listing of the program. (5) Ordered collection of atoms.

**listing** Generally, any printout produced on a printing device. A source listing is a printout of the source program processed by the compiler; an error listing is a report showing all input data found to be invalid by the processing program. See *assembly listing*.

**list processing** Method of processing data in the form of lists. Usually, *chained lists* are used so the logical order of items can be changed without altering their physical locations.

**list processing languages** Languages designed especially to process data in list form, such as IPL, LISP, POP-2, and SAIL.

**literal** Another name for *constant*, a symbol that defines itself. Contrast with *variable*.

**live data** Actual data to be processed by the computer program.

**liveware** Personnel in a computer center or people using hardware and software.

**load** (1) To read information into the storage of a computer. See *get*. (2) To put cards into a card reader, to put a paper tape onto a paper tape reader, or to put a disk pack onto a disk drive unit.

**load-and-go** Operating technique in which the loading and execution phases of a program are performed in one continuous run. See *compile-and-go*.

**loader** Service routine designed to read programs into internal storage in preparation for their execution.

**load module** Computer program in a form suitable to be immediately executed by the circuitry of the computer.

**load point** Spot at the beginning of the recording area of a magnetic tape.

**load sharing** Technique of using two or



```

100 REM *** ODD OR EVEN ***
110 REM *** N - NUMBER ***
120 INPUT "TYPE THE NUMBER"; N
130 IF N = 0 THEN 220
140 REM *** CHECK FOR ODD OR EVEN ***
150 LET X = INT (N/2)
160 LET Y = N/2
170 IF X = Y THEN 200
180 PRINT N;"IS AN ODD NUMBER"
190 GOTO 120
200 PRINT N;"IS AN EVEN NUMBER"
210 GOTO 120
220 END

RUN

TYPE THE NUMBER? 634
634 IS AN EVEN NUMBER
TYPE THE NUMBER? 367
367 IS AN ODD NUMBER

```

Listing

more computers to handle excess volume during peak periods. It is desirable to have one computer handle less than peak loads and the other act as the fallback equipment.

**local** (1) Pertaining to computer equipment at one's own location. (2) Pertaining to items used only in one defined part of a program. Contrast with *global*.

**local area network (LAN)** Communications network connecting various hardware devices together within a building by means of a continuous cable or an in-house voice-data telephone system.

**local intelligence** Processing power and storage capacity built into a terminal so it does not need to be connected to a computer to perform certain tasks. A *dumb terminal* has no local intelligence. See *smart terminal* and *intelligent terminal*.

**local store** Relatively small number of high-speed storage elements that may be directly referred to by the instructions.

**location** Place in the computer's memory where information is to be stored.

**lock** (1) To permit exclusive use of a computer resource. (2) To protect a disk or tape file from being changed or erased.

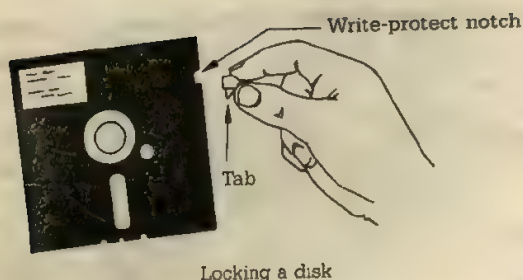
**lock code** Sequence of letters and/or numbers provided by the operators of a time-sharing system to prevent unauthorized tampering with a user's program. Serves as a secret *password* in that the computer will refuse any changes to the program unless the user supplies the correct lock code.

**locked-up keyboard** Situation in which the computer does not respond to key presses.

**locking a disk** A disk is locked when it has been write protected. This measure ensures that the contents of a disk are preserved from being written over by other data from a computer. See *write-protect notch*. (See page 172.)

**lockout** (1) Suppression of an interrupt. (2) Programming technique used in a multiprocessing environment to prevent access to critical data by both CPUs at the same time.

**lock-up** Situation in which no further action may occur.



**log** Record of the operations of data processing equipment, listing each job or run, the time it required, operator actions, and other pertinent data

**logarithm** *Exponent* of the power to which a fixed number is to be raised to produce a given number. The fixed number is called the *base* and is usually 10 or *e*. In the example  $2^3 = 8$ , 3 is the logarithm of 8 to the base 2; this means that 2 must be raised to the third power to produce 8.

**logging-in** Process of establishing communication with, and verifying authority to use, the computer during conversational programming. See *conversational mode* and *sign-on*.

**logging-off** Process of terminating communication between the computer and the user. See *sign-off*.

**logic** (1) Science dealing with the formal principles of reasoning and thought. (2) Basic principles and application of *truth tables* and the interconnection among logical elements required for arithmetic computation in an automatic data processing system.

**logical data design** Design showing relationships among data; how the data is viewed by applications programs or individual users.

**logical decision** Decision as to which of two possible courses of action is to be followed, based upon some comparison of values.

**logical design** Specification of the working relationships among the parts of a system in

terms of symbolic logic and without primary regard for hardware implementation.

**logical error** Programming mistake that causes the wrong processing to take place even though the program is syntactically correct.

**logical file** Collection of one or more *logical records*.

**logical instruction** Instruction that executes an operation defined in symbolic logic, such as *AND*, *OR*, or *NOR*.

**logical multiply** *AND operator*. Compare *logical product*

**logical operations** Computer operations that are logical in nature, such as *logical decisions*. Contrast with *arithmetic operations* and *data transfer operations*, which involve no decision.

**logical product** *AND function* of several terms. The product is 1 only when all of the terms are 1; otherwise it is 0.

**logical record** Complete unit of information that contains all fields describing something. In an inventory file containing 2000 different product items, there are 2000 logical records, one for each item. Contrast with *physical record*.

**logical representation** Knowledge representation consisting of a collection of logical formulas.

**logical sum** *Inclusive OR function* of several terms. The sum is 1 when any or all of the terms are 1; it is 0 only when all are 0.

**logical symbol** See *logic symbol*.

**logical unit number** Number assigned to a physical peripheral device.

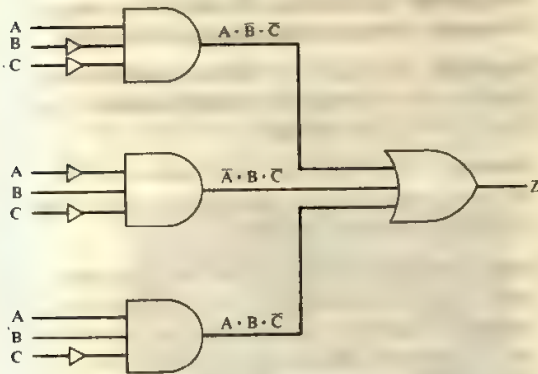
**logical value** Value that may be either true or false, depending on the result of a particular logical decision.

**logic card** Circuit board that contains components and wiring that perform one or more logic functions or operations.



**logic circuits** Series of flip-flops and gates that directs electrical impulses to and from the appropriate portions of a computer system.

**logic diagram** Diagram that represents a logical design and sometimes the hardware implementation:



Logic diagram

**logic element** Device that performs a logic function.

**logic gates** Components in electrical digital circuitry. See *gate*.

**logic operator** Any of the Boolean operators, such as *AND*, *OR*, *NAND*, *exclusive OR*, and *NOR*.

**logic programming** Approach to knowledge representation, usually associated with *PROLOG*, which uses logic and inference to express and solve problems.

**logic seeking** Ability of a printer that works bidirectionally to seek out the shortest printing path.

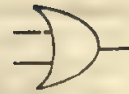
**logic symbol** Symbol used to represent a logic element graphically.

**logic theorist** Early information processing program able to prove theorems.

**logic theory** Science that deals with logical



AND



OR



NAND



NOR



Inverter



Exclusive OR

Logic symbol

operations, which are the basis of computer operations.

**log in** To sign in on a computer. Same as *log on*. Compare *sign-on*.

**log-in name** Name by which the computer system knows a user. Not generally synonymous with *password*.

**LOGO** High-level programming language that assumes the user has access to some type of graphics terminal. Designed for students and easily employed by those in the younger age groups, it has wide-ranging application in graphic reports of business and industry. Highly interactive, permitting users to learn quickly how to draw geometric patterns and pictures on the screen. Developed at the Massachusetts Institute of Technology by Seymour Papert. (See page 174.)

**log on** Action by which a user begins a terminal session. Same as *log in*. Compare *sign-on*.

**log off** To terminate connection with the computer. Same as *log out*. Compare *sign-off*.

log out

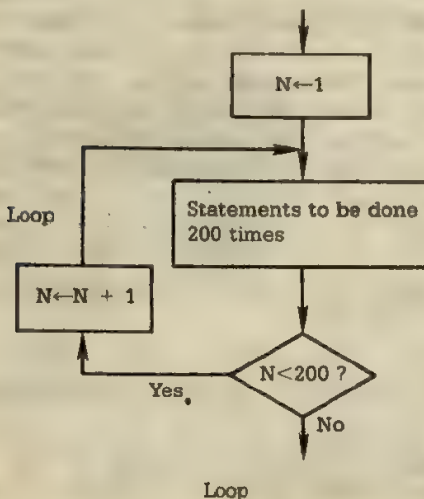
```
TO BOX
10 FORWARD 100
20 RIGHT 90
30 FORWARD 100
40 RIGHT 90
50 FORWARD 100
60 RIGHT 90
70 FORWARD 100
80 RIGHT 90
```

LOGO

**log out** To stop using the computer. Process of signing off the system. Same as *log off*. Compare *sign-off*.

**look-alike** (1) Program that imitates another program so closely that users of the original program can use the look-alike program without learning any new operating instructions. (2) Any product that copies another. Often when a vendor produces a successful product, its competitors offer look-alike products.

**look-up** See *table look-up*.



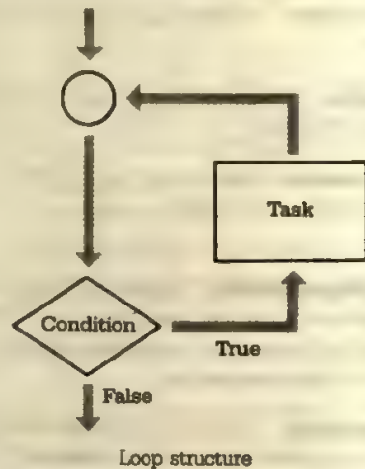
**loop** Sequence of instructions in a program that can be executed repetitively until certain specified conditions are satisfied. See *closed loop* and *endless loop*.

**loop code** Repetition of a sequence of instructions by using a program loop. Loop coding requires more execution time than would straight-line coding but will result in a savings of storage. Contrast with *straight-line code*.

**loophole** Mistake or omission in software or hardware that allows the system's access controls to be circumvented.

**looping** Executing the same instruction or series of instructions over and over again. See *closed loop* and *infinite loop*.

**loop structure** One of three primary structures of a *structured flowchart*. Provides for repetitive execution of a function until a condition is reached. May be a DO WHILE or a DO UNTIL loop. See *sequence structure* and *selection structure*.



**loop technology** Method of connecting communicating machines together in a computer network.

**Lotus 1-2-3®** Integrated software system whose name represents its three functions: spreadsheet, database, and graphics. Combines an electronic worksheet with database.



management. To these are added the ability to produce graphics or pictures of data in the worksheet almost instantly. See *integrated programs*.

**Lovelace, Ada Augusta (1815–1852)** Ada Augusta, Countess of Lovelace, developed the essential ideas of programming. A skilled mathematician and close friend of Charles Babbage, she wrote about his machine: "The *Analytical Engine* weaves algebraical patterns just as the *Jacquard loom* weaves flowers and leaves." See *Ada* and *Babbage, Charles*.



Ada Augusta Lovelace

**low activity** Condition when a small proportion of the total records are processed during an updating run. See *activity ratio*.

**lower case** Noncapitalized alphabetic letters. Some VDTs do not have the capability of using these. Contrast with *upper case*.

**lower-level management** First-line supervisors who make the operating decisions to ensure that specific jobs are done.

**low-level language** Machine-dependent programming language translated by an assembler into instructions and data formats for a given machine. Same as *assembly language*. Contrast with *high-level language*.

	START	256
BEGIN	BALR	15,0
000102	USING	*,15
	L	3,OLD0H
	A	3,RECPT
	S	3,ISSUE
	ST	3,NEW0H
	SVC	0
OLD0H	DC	F'9'
RECPT	DC	F'4'
ISSUE	DC	F'6'
NEW0H	DS	F
	END	BEGIN

Low-level language

**low-order** Pertaining to the digit or digits of a number that have the least weight or significance. In the number 7643215, the low-order digit is 5. Contrast with *high-order*. See *least significant digit*.

**low-order column** Rightmost (highest-numbered) column of a punch card field.

**low-res graphics** Abbreviation of low-resolution graphics, a blocky and jagged picture on a display screen produced by a small number of pixels. Contrast with *hi-res graphics*.

**low-resolution** Pertaining to the quality and accuracy of detail that can be represented by a graphics display. *Resolution* quality depends upon the number of basic image-forming units (*pixels*) within a picture image—the greater the number, the higher the resolution. Low-resolution pictures, produced by a small number of pixels, are not as sharp and clear as *high-resolution* pictures.

**LP** Acronym for *Linear Programming* and *Line Printer*

**LPM** Acronym for *Lines Per Minute*.

**LSC** Acronym for *Least Significant Character*.  
See *least significant digit*.

**LSD** Acronym for *Least Significant Digit*.

**LSI** Acronym for *Large Scale Integration*.

**Lukasiewicz notation** See *Polish notation*.

**luminance** Portions of composite video signal controlling brightness.

**luminance decay** Reduction in screen brightness on a visual display terminal that inevitably occurs over time.

**luminosity** Same as *luminance*.



# M

**M** Abbreviation for mega, meaning one million. Also used to represent 1,048,576. Often used to label the capacity of storage devices, such as disks.

**MacDraw** Drawing program for the Apple Macintosh computer, designed for artists, architects, engineers, draftsmen, and similar professionals in the graphic arts.

**machine address** Same as *absolute address*.

**machine code** Operation code that a machine is designed to recognize.

**machine cycle** Time period it takes for a computer to perform a given number of internal operations.

**machine-dependent** Pertaining to a language or program that works on only one particular type of computer. Synonymous with hardware-dependent. Contrast with *machine-independent*.

**machine error** Deviation from correctness in data resulting from an equipment failure.

**machine-independent** (1) Pertaining to a language or program developed in terms of the problem rather than in terms of the characteristics of the computer system. (2) Pertaining to the ability to run a program on computers made by different manufacturers or on various machines made by the same manufacturer. Contrast with *machine-dependent*.

**machine instruction** Instruction that a computer can directly recognize and execute.

**machine intelligence** See *artificial intelligence*.

**machine language** Basic language of a computer. Programs written in machine language require no further interpretation by a computer. Contrast with *source language*.

**machine learning** Heuristic process whereby a device improves its performance based on past actions. See *artificial intelligence* and *heuristic learning*.

**machine operator** See *computer operator*.

MACHINE LANGUAGE CODING FORM			
Oper	OP 1	OP 2	Comments
100010	000 000 000 000 011	010 110 100 000 000	Load register with C
001100	000 000 000 000 011	011 010 000 000 000	Multiply by B
011100	000 000 000 000 011	010 101 011 000 000	Add A
010111	000 000 000 000 011	100 001 000 000 000	Store as D

Machine language

**machine-oriented language**

**machine-oriented language** Programming language that is more like a machine language than a human language.

**machine-readable information** Information recorded on any medium in such a way that it can be sensed or read by a machine. Also called machine-sensible.

**machine run** See *run*.

**machine-sensible** See *machine-readable information*.

**Macintosh** Popular microcomputer system manufactured by Apple Computer, Inc. Uses a mouse as a primary input device, in addition to a keyboard.

**MacPaint** Sophisticated graphics program for the Macintosh computer. Program provides a very versatile set of tools for graphic expression.

**macro** Single, symbolic programming language statement that, when translated, results in a series of machine-language statements.

**macro assembler** Assembler that allows the user to create and define new computer instructions (called *macro instructions*).

**macro instruction** (1) Source-language instruction equivalent to a specified number of machine-language instructions. (2) Machine-language instruction composed of several *micro instructions*.

**macroprogramming** Programming with *macro instructions*, such as writing control programs for a microprocessor. Contrast with *microprogramming*.

**MacWrite** Word processing application program for the Macintosh computer.

**mag** Abbreviation for magnetic.

**mag card** Magnetic card, developed by IBM Corporation, coated with a magnetic substance on which information is recorded. Frequently used in word processing systems.

**magnetic** Of, producing, caused by, or operated by magnetism.

**magnetic bubble memory** Memory that uses magnetic "bubbles" that move. The bubbles are locally magnetized areas that can move about in a magnetic material, such as a plate of *orthoferrite*. It is possible to control the reading in and out of this bubble within the magnetic material, and as a result, a very high-capacity memory can be built. Andrew Bobeck, Richard Sherwood, Umberto Gianola, and William Shockley, of Bell Laboratories, invented magnetic bubble memory, which has been developed to a storage density of five million bits per square inch.

**magnetic bubbles** Circular magnetic domains having a magnetization opposite that of the substrate, that can be shifted about in the substrate material under the inductive influence of surface control electrodes. Under suitable polarized light, the domains are observable as small circular areas, or bubbles.

**magnetic card** Storage device consisting of a tray or cartridge of magnetically coated cards made of material similar to magnetic tape (although considerably thicker) and with specific areas allocated for storing information. May be visualized as a magnetic tape cut into strips, then placed side by side on a plastic card and mounted on a cartridge. See *data cell*.

**magnetic characters** Set of characters—used for checks, insurance billings, utility bills, invoices, and so forth—that permit special character-reading devices (MICR readers) to be employed to read the characters automatically. See *magnetic ink character recognition*.

**magnetic core** Tiny, doughnut-shaped piece of magnetizable material capable of storing one binary digit.

**magnetic core plane** Network of *magnetic cores*, each of which represents one core common to each storage location. A number of core planes are stacked together to form a *magnetic core storage* unit.



**magnetic core storage** System of storage in which data is represented in binary form by means of the directional flow of magnetic fields in tiny, doughnut-shaped arrays of magnetic cores. Retains stored data in the event of a power loss. Used in older computers. Contrast with *volatile storage*.

**magnetic disk** Disk made of rigid material (hard disk) or heavy Mylar (floppy disk). The disk surface is used to hold magnetized data, which is written on the disk and retrieved from the disk by a *disk drive*.

**magnetic disk unit** Peripheral storage device in which data are recorded on a magnetizable disk surface. See *direct access*, *disk pack*, *fixed-head disk unit*, *floppy disk*, and *movable-head disk unit*.

**magnetic domain** Magnetized spot representing data in bubble memory.

**magnetic drum** Peripheral storage device consisting of a cylinder with a magnetizable surface on which data are recorded. See *direct access*.

**magnetic film storage** Storage device that uses 35-mm magnetic film contained on a spool. The spool may be loaded onto a film handler unit.

**magnetic head** Device used for reading and writing information on devices such as magnetic tapes, disks, or drums. See *read/write head*.

**magnetic ink** Ink that contains particles of a magnetic substance whose presence can be detected by magnetic sensors.

**magnetic ink character reader** Input device that reads documents imprinted with magnetic ink characters. Also called MICR reader.

**magnetic ink character recognition (MICR)** Recognition, by machines, of characters printed with a special magnetic ink. Used primarily in the banking, credit card, and public utilities industries.

**magnetic media** Generic name for floppy disks, tapes, and any other devices that store data in the form of magnetic impulses.

1234567890

Name		3662	
Address			
City, State, Zip Code		June 30 19 87 25-3/440	
PAY TO THE	Bill Wilson	\$ 2.50	
ORDER OF	Two and 50/100	DOLLARS	
Name of Bank			
City, State, Zip Code		Susan Walker	
MEMO	044000037	32-06303	3662
			000000250
ABA transit number	Account number	Check amount	
Check routing number			

Magnetic ink character recognition

## magnetic printer

**magnetic printer** Nonimpact printer that uses charged particles written by a dot matrix device.

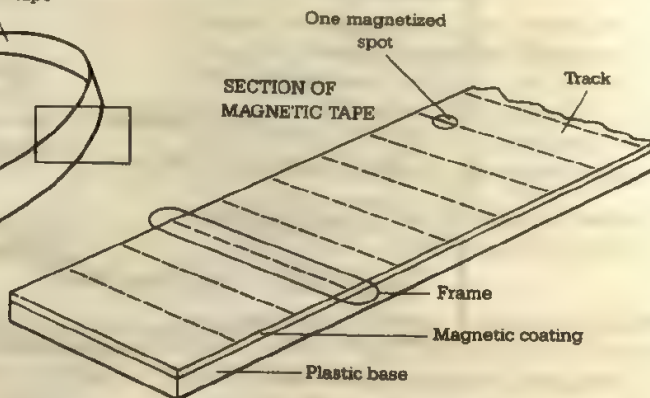
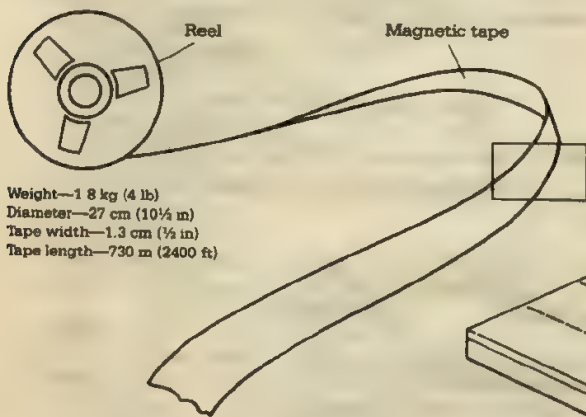
**magnetic resonance** Phenomenon in which a movement of a particle or system of particles is coupled resonantly to an external magnetic field.

**magnetic storage** Any system that utilizes the magnetic properties of materials to store data on such devices and media as disks, tapes, cards, drums, cores, and film.

**magnetic strip card** Small card resembling a credit card to which a strip of magnetizable material is affixed. Information can be read from or written on this magnetic strip. See *magstripe*.

**magnetic tape** Plastic tape having a magnetic surface for storing data in a code of magnetized spots. Information may be represented on tape using an 8-bit coding structure. A reel of tape is about 750 meters (2400 feet) in length. Information is written on the tape and retrieved from the tape by a tape drive.

**magnetic tape cartridge** Magnetic tape contained in a cartridge. The cartridge consists of a reel of tape and the take-up reel. Similar to a cassette but of slightly different design.



**magnetic tape cassette** Magnetic tape storage device consisting of  $\frac{1}{8}$ -inch magnetic tape housed in a plastic container.

**magnetic tape cassette recorder** Input/output and storage device that reads and writes cassette tapes. Used widely with micro-computer systems.

**magnetic tape code** System of coding used to record magnetized patterns on magnetic tape. The magnetized patterns represent alphanumeric data. See *binary coded decimal* and *EBCDIC*.

**magnetic tape deck** Same as *magnetic tape unit*.

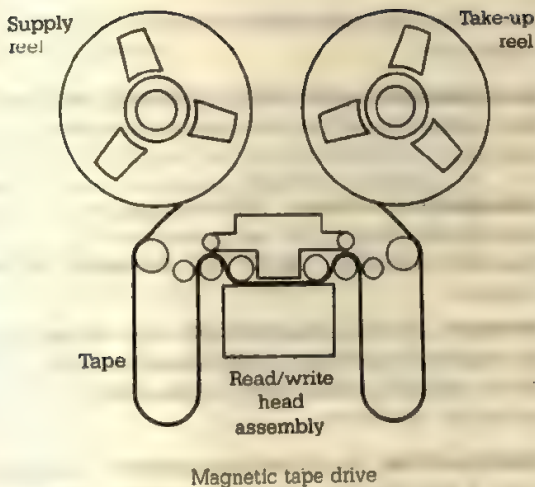
**magnetic tape density** Number of characters that can be recorded on 2.54 cm (1 in.) of magnetic tape. Common densities are 800 and 1600 cpi, but some devices can record and read 6250 cpi.

**magnetic tape drive** Device that moves tape past a head. Synonymous with *magnetic tape transport*.

**magnetic tape reel** Reel used to preserve the physical characteristics of magnetic tape. The tape is usually 1.27 cm ( $\frac{1}{2}$  in.) wide and 751.52 m (2400 ft.) in length.

Magnetic tape





**magnetic tape sorting** Sort program that uses magnetic tapes for auxiliary storage during a sort.

**magnetic tape transport** Same as *magnetic tape drive*.

**magnetic tape unit** Device containing a magnetic tape drive together with reading and writing heads and associated controls. Synonymous with *magnetic tape deck*. See *magnetic tape cartridge* and *magnetic tape cassette*.

**magnetic thin film** See *thin film*.

**magnitude** (1) Absolute value of a number.  
(2) Size of anything.

**magstripe** Small stripe of magnetic material found on the back of most major cards and computerized transit fare cards. Contains information such as account number and card holder's name or points of entry and exit and amount of paid fare remaining.

**magtape** *Magnetic tape*.

**Mahon, Charles** (1753–1816) Third Earl of Stanhope, who invented the Stanhope Demonstrator in 1777, the first arithmetical machine that used geared wheels.

**mail box** Set of locations in a storage area.

Area reserved for data addressed to specific peripheral devices or other processors

**mailing list program** Program that maintains names, addresses, and related data, and produces mailing labels.

**mail-merging** Process of automatically printing form letters with names and addresses from a mailing list file. A mail-merge program merges address information from one file with textual information from another file.

**mainframe** Large, expensive computer generally used for information processing in large businesses, colleges, and organizations. Originally, the phrase referred to the extensive array of large rack and panel cabinets that held thousands of vacuum tubes in early computers. Mainframes can occupy an entire room and have very large data-handling capacities. Far more costly than *microcomputers* or *minicomputers*, mainframes are the largest, fastest, and most expensive class of computers. (Supercomputers are the largest, fastest, and most expensive of the mainframes).

**main-line program** Section of a program that controls the order of execution of other modules in the program.

**main memory** Same as *internal storage*.

**main storage** Addressable storage directly controlled by the central processing unit. Used to store programs while they are being executed and data while they are being processed. Same as *internal storage* and *primary storage*. Contrast with *auxiliary storage*.

**maintainability** Characteristic associated with the isolation and repair of a failure.

**maintenance** Any activity intended to eliminate faults or to keep hardware or programs in satisfactory working condition, including tests, measurements, replacements, adjustments, and repairs.

**maintenance programmer** Individual who works with programs that have already been

## **maintenance routine**

implemented into an information system, making changes as needed from time to time. See *software maintenance*.

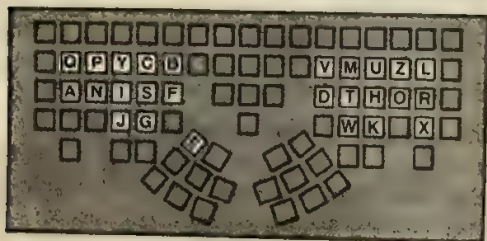
**maintenance routine** Routine designed to help a *customer engineer* carry out routine *preventive maintenance* on a computer system.

**major sort key** Field containing data (such as a last name) by which most data items can be distinguished and sorted. When duplications occur in this field, a *minor sort key* (such as a first name) may supply the necessary distinction.

**male connector** Rigid *plug* designed to fit into a *jack* for making electrical connections. Contrast with *female connector*.

**malfunction** Failure in the operation of the central processing unit or peripheral device. The effect of a *fault*. Contrast with *error* and *mistake*. See *crash*.

**Malttron keyboard** Keyboard layout that allows potentially much faster speeds, and is easier to learn than the traditional *QWERTY* keyboard layout. Compare *Dvorak keyboard*.



Malttron keyboard

**management graphics** Charts, graphs, and other visual representations of the operational or strategic aspects of a business, intended to aid management in assimilating and presenting business data.

## **management information system (MIS)**

Any information system designed to supply organizational managers with the necessary information needed to plan, organize, staff, di-

rect, and control the operations of the organization.

**management report** Report designed to help managers and decision makers perform their jobs.

**management science** Mathematical or quantitative study of the management of a business's resources, usually with the aid of a computer.

**manager** Person responsible for guiding the operations of a computer center, programming group, software development group, service organization, and so on.

**manipulating** Act of working on data to put it into a form that has greater meaning to the user.

**manpower loading chart** Histogram showing the allocation of labor by time period.

**mantissa** That part of a floating-point number that specifies the significant digits of the number. In  $0.64321 \times 10^3$ , .64321 is the mantissa. See *characteristic*.

**manual input** Data entered manually by the computer user to modify, continue, or resume processing of a computer program.

**manual operation** Processing of data in a system by direct manual techniques.

**manufacturer's software** Set of programming aids that the computer manufacturer supplies or makes available with a computer. See *systems programs*.

**map** List that indicates the area of storage occupied by various elements of a program and its data. Also called *storage map*.

**mapping** Transformation from one set to another set; a correspondence. For example, the process by which a graphic system translates graphic data from one coordinate system into a form useful on another coordinate system. See *symbolic table*.

**margin** Number of spaces between the right



or left edge of a page (or window) and the beginning of text.

**marginal checking** *Preventive maintenance* procedure in which the unit under test is varied from its normal value in an effort to detect and locate components that are operating in a marginal condition.

**mark** Sign or symbol used to signify or indicate an event in time or space.

**marker** Symbol used within a line chart to indicate data points. Styles often used include circles, Xs, asterisks, boxes, diamonds, and points.

**MARK 1** Short for *HARVARD MARK 1*.

**mark sensing** Ability to mark cards or pages with a pencil to be read directly into the computer via a mark sense reader. Very useful technique for acquiring data by hand and for avoiding the time lag and potential inaccuracy of keypunching. See *optical mark reader*.

**maser** Acronym for Microwave Amplification by the Stimulated Emission of Radiation, a device capable of amplifying or generating radio frequency radiation. Maser amplifiers are used in satellite communication ground stations to amplify the extremely weak signals received from communications satellites.

**mask** (1) Machine word containing a pattern of bits, bytes, or characters used to extract or select parts of other machine words by controlling an instruction that retains or eliminates selected bits, bytes, or characters. (2) In integrated circuit development, the full-sized photographic representation of a circuit designed on the system for use in the production process.

**mask design** Final phase of integrated circuit design by which the circuit design is realized through multiple masks corresponding to multiple layers on the integrated circuit. The mask layout must observe all process-related constraints, and minimize the area the circuit will occupy.

**massage** To process data.

**mass storage device** Any device used to supply relatively inexpensive storage for large amounts of data. Examples are hard disks, vid-eodisks, *bubble memory*, large magnetic disk systems, and mass storage cartridge systems holding up to almost 500 billion characters. See *optical disk*.

**master clear** Switch on some computer consoles that will clear certain operational registers and prepare for a new mode of operation.

**master clock** Device that controls the basic timing pulses of a computer.

**master data** Set of data that is altered infrequently and supplies basic data for processing operations.

**master file** File containing relatively permanent information used as a source of reference and generally updated periodically. Contrast with *detail file*.

**master file maintenance** Process of updating, changing, or modifying master files.

**master/slave computer system** Computer system consisting of a master computer connected to one or more slave computers. The master computer provides the scheduling function and jobs to the slave computer(s).

**match** To check for identity between two or more items of data. Compare *hit*.

**matching** Data processing operation in which two files are checked to determine whether there is a corresponding item or group of items in each file.

**material requirements planning** Computerized inventory control techniques for dependent inventory items.

**mathematical functions** Set of mathematical routines available in most programming languages. Usually supplied as part of the language.

## mathematical logic

**mathematical logic** Use of mathematical symbols to represent language and its processes. These symbols are manipulated in accord with mathematical rules to determine whether or not a statement or a series of statements is true or false. See *logic*.

**mathematical model** Group of mathematical expressions that represents a process, a system, or the operation of a device. See *simulation*.

**mathematical symbols** Symbols used in formulas, equations, and flowcharts.

\* or  $\times$  or  $\cdot$  multiplied by  
+ or  $\div$  divided by  
+ positive; add  
- negative; subtract  
 $\pm$  plus or minus  
= is equal to  
 $\equiv$  identity  
 $\approx$  is similar to  
 $\neq$  does not equal  
> is greater than  
< is less than  
 $\geq$  is greater than or equal to  
 $\leq$  is less than or equal to  
 $\therefore$  therefore  
 $\angle$  angle  
 $\Delta$  increment or decrement  
 $\perp$  is perpendicular to  
 $\parallel$  is parallel to

Mathematical symbols

**mathematics** Study of the relationships among objects or quantities, organized so that certain facts can be proved or derived from others by using logic. See *applied mathematics*.

**matrix** Orderly array of symbols by rows and columns. The symbols comprising the matrix are called *elements* or *entries* of the matrix. *Subscripts*, are customarily used to indicate the row and column positions of an element in any matrix. Matrices provide a way in which complicated mathematical statements can be

expressed simply. Computers are often used in work with matrices.

Column					
4	3	6	9	5	6
2	1	4	5	8	2
6	2	5	1	9	3
8	2	2	3	9	1
Row					

Matrix

**matrix notation** Introduced by English mathematician Arthur Cayley in 1858. He used an abbreviated notation, such as  $ax=b$ , for expressing systems of linear equations.

**matrix printer** Character printer that uses a matrix of dots to form an image of the character being printed. See *dot matrix printer*.

**mature system** System that is fully operational and performing all the functions it was designed to accomplish.

**Mauchly, John** (1907–1980) Coinventor of *ENIAC*, the first large-scale all-electronic computer. In the 1930s, while head of the Physics Department at Ursinus College in Pennsylvania, Mauchly began experimenting with computers and electronics. During his eight years at the school, he worked on a weather analysis project that led him to the conviction that a high-speed electronic device was necessary to perform complex environmental calculations. In 1941, he joined the Moore School of Electrical Engineering at the University of Pennsylvania, where he met J. Presper Eckert. In early 1943, the two men submitted a proposal to the U.S. Army describing an electronic computer; the Army's Ordnance Department later issued a contract to them to build the machine. The Army needed calculated tables that would indi-



cate to its artillerymen how to aim new guns being developed for World War II. The Moore School had been calculating these tables, but with methods that were proving too slow. Between 1943 and 1946, Eckert and Mauchly developed the Electronic Numerical Integrator and Computer, a landmark leading to the development of many future computer designs. ENIAC was literally a giant. It contained more than 18 000 vacuum tubes, weighed 30 tons, and occupied a room the size of an average three-bedroom house. Following the development of ENIAC, Eckert and Mauchly established their own company. They developed a second computer in 1949 called BINAC (Binary Automatic Computer), which served as a test of the plans they had formulated for UNIVAC I, the world's first general-purpose commercial computer. In 1951, UNIVAC I was installed at the U.S. Census Bureau. The corporation formed by Eckert and Mauchly is now part of Sperry Corporation, a large manufacturer of computing equipment. See *Eckert, J. Presper*.

**maximinicomputer** Largest type of minicomputer that uses 16-bit words. Contrast with *miniminicomputer*, *midminicomputer*, and *superminicomputer*.

**mb** Abbreviation for *megabyte*.

**MCC** Acronym for Microelectronics and Computer Technology Corporation, a United States consortium of 13 companies formed to conduct research in advanced computers.

**McCarthy, John** In 1958, created the programming language LISP. Also developed the concept of *interactive* computing (while at M.I.T.) and coined the term *artificial intelligence*. Best known for his work associated with artificial intelligence.

**means/ends analysis** Method of reasoning that looks backward and forward from the initial point to the goal in an attempt to reduce differences.

**mechanical data processing** Method of data processing that involves the use of relatively small and simple (usually nonprogrammable) mechanical machines.

**mechanical translation** Generic term for language translation by computers or similar equipment.

**mechanization** Use of machines to simplify or replace work previously accomplished by human workers. Compare *automation*.

**media** Plural form of "medium." See *source media*, *input media*, and *output media*.

**media eraser** Device designed to demagnetize magnetic tapes and diskettes. See *degausser*.

**media specialist** Person responsible for cataloging and maintaining storage media such as diskettes, disk packs, magnetic tapes, and other related materials. See *custodian*.

**medium** Any physical substance upon which data are recorded, such as floppy disk, magnetic disk, paper tape, magnetic tape, punch cards, and paper.

**medium scale integration (MSI)** Class of integrated circuits having a density between those of *large scale integration* and *small scale integration*. See *transistor-transistor logic*. Compare *very large scale integration* and *super large scale integration*.

**mega** Prefix indicating one million, or  $10^6$ . Abbreviated M. Contrast with *micro*, one millionth.

**megabit** Loosely, 1 million bits or 1 thousand kilobits. Actually, 1,048,576 bits, or 1024 kilobits.

**megabyte** Specifically,  $2^{20}$ , or 1,048,576 bytes; 1024 kilobytes. Roughly, 1 million bytes or 1 thousand kilobytes. Abbreviated MB. Compare *gigabyte* and *terabyte*.

**megacycle** One million cycles per second.

megaflop

**megaflop** One million floating-point operations per second. Also called *M flops*.

**megahertz** Unit of electrical frequency equal to one million cycles per second, a measure of transmission frequency. Abbreviated MHz.

**membrane keyboard** Keyboard constructed of two thin plastic sheets (membranes) coated with a circuit made of electrically conductive ink. An economical, flat keyboard used in several low-priced microcomputers.

**memory** Storage facilities of the computer, capable of storing vast amounts of data. See *auxiliary storage*, *floppy disk*, *internal storage*, *magnetic bubble memory*, *magnetic core storage*, *magnetic disk*, *magnetic drum*, *magnetic tape*, *PROM*, *RAM*, *ROM*, *semiconductor storage*, *storage*, and *virtual storage*.

**memory allocation** See *storage allocation*.

**memory board** Expansion board that adds RAM to the computer system, making it possible to store and use additional information.

**memory chip** Semiconductor device that stores information in the form of electrical charges. Usually located on *memory boards* or *system boards*.

**memory cycle** Amount of time required to move one byte or word of information into or out of memory.

**memory dump** Printout showing the contents of memory. Also called *storage dump*.

**memory management** Technique of efficiently controlling and allocating memory resources.

**memory map** Image in memory of information appearing somewhere else. For example, in a display unit there is a memory map of the screen display, with one memory location corresponding to each character position on the display.

**memory protection** See *storage protection*.

**memory sniffing** Continuous testing of storage during processing.

**menu** List of options within a program that allows the user to choose which part to interact with. Allows computer users a facility for using programs without knowing any technical methods. Usually an onscreen series of program options

#### EDITING A MENU

```
A*  CREATE A NEW FILE
B*  EDIT AN EXISTING FILE
C*  COPY A DOCUMENT
D*  NAME A FILE
E*  FORMAT A FILE
F*  PRINT A FILE
G*  EXIT TO SYSTEM
```

#### Menu

**menu-driven software** Computer programs that make extensive use of menus. Software of this type is designed so it may be used easily by people with minimal computer experience. Menus are used to select tasks to be performed.

**menu item** Any choice in a menu.

**merge** To combine items into one sequenced file without changing the order of the items. Same as *collate*.

**merge-print program** Program that lets the user produce personalized form letters

**MESFET** Acronym for MEtal Semiconductor Field Effect Transistor, the main active device used in gallium arsenide integrated circuits to provide current gain and inversion.

**mesh** Set of branches forming a closed path in a network.



**mesh network** Network in which nodes are connected to several other nodes (possibly each node is connected to every other) allowing a variety of paths for transmission of messages. Contrast with *ring network*. See *network topologies*.

**message** Group of characters having meaning as a whole and always handled as a group.

**message format** Rules for the placement of such portions of a message as message heading, address text, and end of message.

**message header** Leading part of a message that contains information concerning the message, such as the source or destination code, priority, and type of message.

**message queuing** In a data communications system, a technique for controlling the handling of messages, allowing them to be accepted by a computer and stored until they have been processed or routed to another destination.

**message retrieval** Capability to retrieve a message sometime after it has entered an information system.

**message switching** Switching technique of receiving a message, storing it until the proper outgoing circuit and station are available, and then retransmitting it toward its destination. Computers are often used to perform the switching function.

**message switching center** Center in which messages are routed according to information contained within the messages themselves.

**metacharacter** In programming language systems, these characters have some controlling role in respect to the other characters with which they are associated.

**metacompiler** Compiler for a language used primarily for written compilers, usually syntax-oriented compilers. A special-purpose

metacompiler language is not very useful for writing general programs.

**metalanguage** Language used to describe a language.

**metallic oxide semiconductor (MOS)** (1) Field effect transistor in which the gate electrode is isolated from the channel by an oxide film. See *MOSFET*. (2) Capacitor in which semiconductor material forms one plate, aluminum forms the other plate, and an oxide forms the dielectric. See *complementary MOS*.

**meta-metalanguage** Language used to describe a metalanguage.

**methodology** Procedure or collection of techniques used to analyze information in an orderly manner. Set of standardized procedures, including technical methods, management techniques and documentation that provide the framework to accomplish a particular function.

**metric system** Systeme International d'Unites, or SI, the modern version of the metric system currently in use worldwide. It is based on seven base units: meter, kilogram, second, ampere, Kelvin (degrees Celsius), candela, and mole.

**M flops** One million floating-point operations per second. Short for *megaflop*.

**MFT** Acronym for Multiprogramming with a Fixed number of Tasks, the tasks being programs. (Sometimes jokingly called Multiprogramming with a Finite amount of Trouble.) Contrast with *MVT*.

**MHz** Abbreviation for *megahertz*, a million cycles per second.

**MICR** Acronym for *Magnetic Ink Character Recognition*.

**micro** (1) One millionth, used as a prefix; for example, a microsecond is a millionth of a second. (2) Computerese for "quite small," as in microcomputer. From the Greek letter mu,

## microchart

meaning "very small." Contrast with *mega*, one million.

**microchart** Chart showing the ultimate details of the program's or system's design.

**microchip** Tiny silicon chip with thousands of electronic components and circuit patterns etched on its surface.

**microcode** Sequence of basic subcommands, or pseudocommands, built into the computer and executed automatically by hardware. Generally, in a special read-only storage unit (*firmware*), these commands define the instruction set of a *microprogrammable* computer.

**microcoding** Composing computer instructions by combining basic, elementary operations or subcommands to form higher-level instructions, such as addition or multiplication. See *micro instruction*, *microprogrammable computer*, and *microprogramming*.

**microcoding device** Circuit board with fixed instructions for performing standard functions through miniature logic circuits, thus avoiding the need to code these instructions during programming.

**microcomputer** (1) Smallest and least expensive class of computers. They are fully operational computers that use microprocessors as their CPU. Used in the home as personal computers; also widely used in schools and businesses. (2) Any small, low-cost computer that performs input, processing, storage, and output operations following a set of instructions. See *desktop computer*, *home computer*, *lap computer*, *notebook computer*, *personal computer*, and *portable computer*.

**microcomputer applications** Microcomputers are finding applications in business, technology, industry, and the home. They are used in video game machines, traffic control systems, point-of-sale terminals, scientific instruments, blood analyzers, credit card verification, pinball machines, automotive ignition control, and inventory control systems. Industry is using microcomputers and microproces-

sors in microwave ovens, sewing machines, flow meters, gas station pumps, paint mixing machines, process monitoring, pollution monitoring, and as control units for hundreds of other devices. Home uses include education from preschool through college, household budgets, banking and bill paying, and stock market monitoring.

**microcomputer chip** Microcomputer on a chip. Differs from a *microprocessor* in that it not only contains the CPU but also includes, on the same piece of silicon, a RAM, a ROM, and input/output circuitry. Often called a *computer-on-a-chip*. See *microcomputer*.

**microcomputer components** The major components of a microcomputer are a microprocessor, a memory (ROM, PROM, EPROM, RAM), and input/output circuitry.

**microcomputer development system** Complete microcomputer system used to test and develop both the hardware and software of other microcomputer-based systems from initial development through debugging of final prototypes. Typically includes assembler facilities, a text editor, debugging facilities, hardware emulation capabilities, PROM programmer, monitor, and disk/tape I/O system.

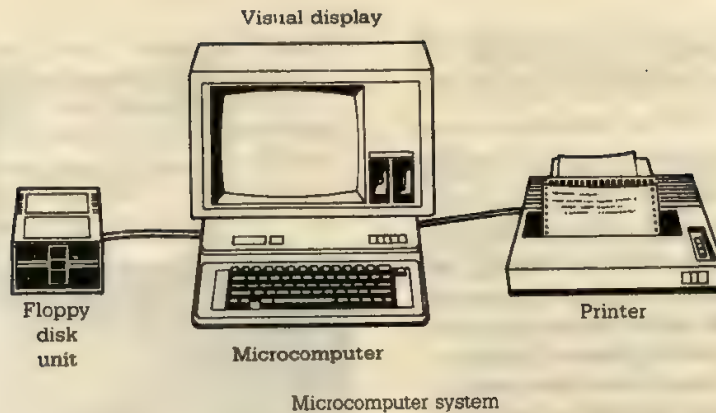
**microcomputer kit** See *computer kit*.

**microcomputer system** System that includes a microcomputer, peripherals, operating system, and applications programs.

**microcontroller** Device or instrument that controls a process with high resolution, usually over a narrow region. A microprogrammed machine (*microcomputer* or *microprocessor*) used in a control operation; that is, to direct or make changes in a process or operation. For example, the Singer Company uses a microcontroller and a ROM to operate sewing machines.

**microelectronics** Field that deals with techniques for producing miniature circuits, such as integrated circuits, thin film techniques, and solid logic modules.





**microfiche** Sheet of microfilm about 10 cm by 15 cm (4 in. by 6 in.) upon which the images of computer output may be recorded. Up to 270 pages of output may be recorded on one sheet of *fiche*. See *computer output microfilm recorder* and *ultrafiche*.

**microfilm** Photographic film used for recording graphic information in a reduced size. See *computer output microfilm recorder*.

**micro floppy disk** Floppy disk with a diameter less than 9 cm ( $3\frac{1}{2}$  in.).

**microform** Medium that contains miniaturized images, such as microfiche and microfilm.

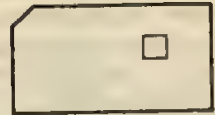
**micrographics** Use of miniature photography to condense, store, and retrieve graphics information. Involves the usage of all types of microforms and microimages, such as microfilm, microfiche, and computer output microfilm.

**micro instructions** Low-level instructions used to obtain a *macro instruction* in machine language or in a source language available to the computer user. See *microprogramming*.

**microjustification** In some word processing programs, the ability to add small slivers of blank space between words and between letters within words. The result is easier to read than ordinary justified copy, in which the computer merely adjusts space between words. See *microspacing*.



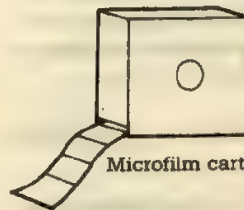
Microfilm strip



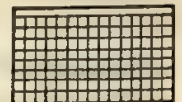
Aperture card with 35-mm microfilm



16-mm microfilm



Microfilm cartridge



Microfiche

Microfilm

**micrologic** Use of a permanent stored program to interpret instructions in a microprogram.

**microminature chip** An LSI or VLSI chip used for computer storage (memory chip) or control (microprocessor chip).

**microminiaturization** Term implying very small size, one step smaller than *miniaturization*.

**micron** One millionth of a meter, or approximately  $1/25,000$  of an inch.

**microprocessor** Basic arithmetic, logic, and control elements required for processing, generally contained on one integrated circuit chip. Widely used as the control devices for microcomputers, household appliances, business machines, calculating devices, toys, video game machines, and thousands of other devices.

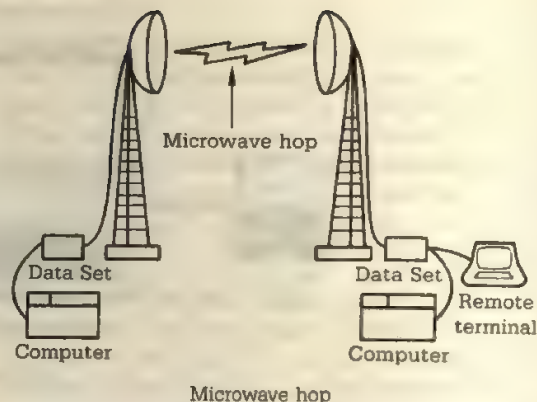
**microprogrammable computer** Any computer whose instruction set is not fixed but can be tailored to individual needs by the programming of ROMs or other memory devices. Consequently, whether the computer is a mainframe, minicomputer, or microcomputer, theoretically it can be microprogrammed. See *microprogramming*.

**microprogramming** Method of operating the control part of a computer in which each instruction is broken into several small steps (microsteps) that form part of a microprogram. Some systems allow users to microprogram, and hence determine the instruction set of, their own machine. See *microcode* and *microprogrammable computer*.

**microsecond** One millionth of a second; abbreviated  $\mu\text{s}$  or  $\mu\text{sec}$ .

**microspacing** Feature of some printers that allows them to move extremely small distances. Used to do *microjustification* and *shadow printing*. Also called incremental spacing.

**microwave** Electromagnetic wave that has a wavelength in the centimeter range. Microwaves occupy a region in the electromagnetic spectrum bounded by radio waves on the side of longer wavelengths and by infrared waves on the side of shorter wavelengths. Used in data communications.



**microwave hop** Microwave radio channel between two dish antennas aimed at each other.

**microwave transmission lines** Structures used for transmission of electromagnetic energy at microwave frequencies from one point to another.

**MICR reader** Input device that reads documents imprinted with magnetic ink characters.

**midiminicomputer** Medium-size minicomputer that uses 16-bit words. Contrast with *miniminicomputer*, *maximinicomputer*, and *superminicomputer*.

**milestone** See *event*.

**milli** One thousandth, used as a prefix; a millisecond is a thousandth of a second. Contrast with *kilo*, thousand.

**millimicrosecond** Same as *nanosecond*, one billionth of a second.

**millisecond** One thousandth of a second; abbreviated *ms* or *msec*.

**mini** Short for *minicomputer*.

**miniaturization** Process of making an object smaller in physical size without decreasing its efficiency. Compare *microminiaturization*.

**minicomputer** Digital computer distinguished from a *microcomputer* by higher performance, more powerful instruction sets, a



higher price, and a wider selection of available programming languages and operating systems. Distinguished from a *mainframe* by smaller size, lower cost, and less data-handling capacity. Minicomputer systems are divided into four operational classes: *mini-*, *midi-*, *maxi-*, and *superminicomputers*.



Minicomputer

**mini floppy disk** Diskette with 13.3-cm ( $5\frac{1}{4}$ -in.) diameter, used in microcomputer systems. See *floppy disk*, *magnetic disk*, and *micro floppy disk*.

**minimal tree** Tree whose terminal nodes are ordered to make the tree operate at optimum. See *optimal merge tree*.

**minimax** Technique for minimizing the maximal error of a process.

**miniminicomputer** Smallest classification of minicomputer systems. Possesses a limited set of operational features. Contrast with *midiminicomputer*, *maximinicomputer*, and *superminicomputer*.

**minor sort key** Data field that provides a secondary source of distinctions by which to sort records. Used only when duplications occur in the *major sort key*.

**mips** One million instructions per second. Used to describe the average number of machine-language instructions a large computer performs in one second.

**mirroring** Display or creation of graphic data that portrays an image in exactly the reverse orientation it originally had. Many computer graphics systems will automatically create a mirror image of a graphic entity on the display screen by flipping the entity or drawing on its X or Y axis.

**MIS** Acronym for *Management Information System*.

**mistake** Human failing that produces an unintended result, such as faulty arithmetic, use of incorrect computer instructions, incorrect keypunching, or use of incorrect formulas in a computer program. See *bug*. Contrast with *error*, *fault*, and *malfunction*.

**mixed number** Number having both a fractional part and an *integer* part, such as 63.71, -18.006, and 298.413.

**ML** Acronym for Manipulator Language, an IBM Corporation programming language for controlling *robots*. See *robot control languages*.

**mnemonic** (1) Pertaining to any technique used to aid human memory. (2) Word or name that is easy to remember and identify

**mnemonic code** Easy-to-remember assembly-language code; for example, a code that uses an abbreviation such as MPY for "multiply."

**mnemonic language** Programming language based on easily remembered symbols that can be assembled into machine language by the computer.

**mode** (1) Method of operation. (2) Form of a

model

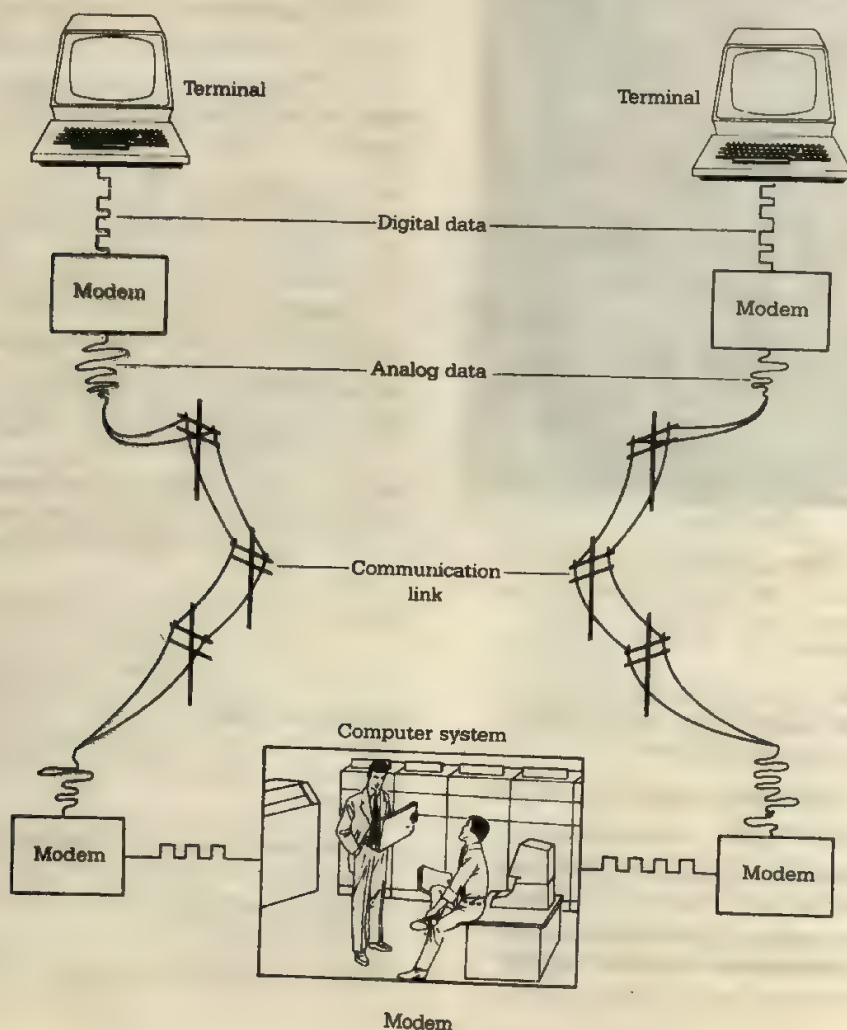
number, name, or expression. (3) Most common or frequent value in a group of values.

**model** Representation of certain key features of an object or system to be studied. Scientific models often make use of complex formulas and involve substantial use of mathematics. If a computer is used to solve the equations and carry out the necessary calculations, the process is called a computer *simulation*. Modeling and simulation are essential tools in every area of science, business, economics, and a number of other fields.

**model, geometric** Complete, geometrically accurate 3-D or 2-D representation of a shape, a part, or a geographic area, designed on a computer graphics system and stored in the database.

**modeling** Process of accurately describing or representing certain parts of a system. See *model* and *simulation*.

**modem** Acronym for MOdulator/DEModulator, a device that translates digital pulses from a computer into analog signals for





telephone transmission, and analog signals from the telephone into digital pulses the computer can understand. Provides communication capabilities between computer equipment over common telephone facilities. Same as *data set*. See *acoustic modem*.

**modify** (1) To alter a portion of an instruction so its interpretation and execution will be other than normal. The modification may permanently change the instruction or leave it unchanged and affect only the current execution. (2) To alter a program according to a defined parameter.

**modular coding** Technique of programming in which the logical parts of a program are divided into a series of individual modules or routines so that each routine may be programmed independently. See *top-down programming*.

**modular constraint** In computer graphics, a limitation on the placement of images such that some or all points of an image are forced to lie on the intersections of an invisible grid.

**modularity** Concept of designing computers in a *building-block* format to promote efficient and economical upgrading of equipment.

**modular programming** Programming that produces relatively small, easily interchanged, computer routines that meet standardized interface requirements. Modularity is accomplished by breaking the program into limited segments that perform complete functions and are therefore understandable in themselves. Greatly facilitates development and verification of complex programs and systems. See *module* and *structured programming*.

**modulation** In data communications, the process by which some characteristic of a high-frequency carrier signal is varied in accordance with another, lower-frequency "information" signal. Used in *data sets* to make computer terminal signals compatible with communications facilities. Counterpart to *demodulation*. See *modem*.

**modulator** Device that receives electrical pulses, or bits, from a data processing machine and converts them into signals suitable for transmission over a communications link. Contrast with *demodulator*.

**module** (1) One logical part of a program. A major program may be broken down into a number of logically self-contained modules. These modules may be written (and possibly tested separately) by a number of programmers. The modules can then be put together to form the complete program. This is called *modular programming*. (2) Interchangeable plug-in item containing components.

**modulo** Mathematical function that yields the remainder of division. A number  $x$  evaluated modulo  $n$  gives the integer remainder of  $x/n$ . For example, 1000 modulo 84 equals the remainder of 1000/84, or 76.

**monadic** Pertaining to an operation that uses only one *operand*. Contrast with *niladic*.

**monadic Boolean operator** Boolean operator with only one operand, such as the NOT operator.

**monitor** (1) Control program or supervisor. See *operating system*. (2) Video display. See *video monitor*.

**monochrome card** Circuit board that installs in a computer's expansion slots and generates a one-color signal (normally white/amber/green, depending upon monitor used).

**monochrome monitor** Special display device that displays a single-color (white, amber, or green) character set on a contrasting (black) background, producing a sharp, clear display that is easy to read. Often used in word processing applications, business systems, and educational applications that may require many hours at the computer terminals and that do not require multicolor displays. See *composite video* and *RGB video*.

**monolithic** (1) Pertaining to a single silicon substrate upon which an integrated circuit is

## monolithic integrated circuit

constructed. (2) Complete and all in one piece. For example, a linkage editor combines several fragmentary program modules into a single monolithic program.

**monolithic integrated circuit** Circuit formed in a single piece of the substrate material, as opposed to a hybrid circuit, in which individual (physically separate) circuit components are electrically interconnected to form the final circuit.

**Monroe, Jay R.** In 1911, using earlier designs of Frank Baldwin, developed the first keyboard rotary machine to attain commercial success

**Monte Carlo method** Trial-and-error method of repeated calculations to discover the best solution to a problem. Often used when a great number of variables are present with interrelationships so extremely complex as to eliminate straightforward analytical handling.

**more than** See *greater than*.

**Morlund, Samuel** (1625–1695) Improved on *Napier's bones* to invent a multiplier, and in 1666 invented an arithmetical machine that could calculate the four processes of arithmetic.

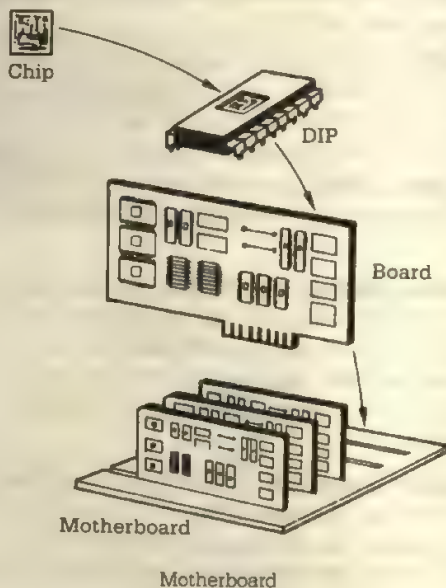
**MOS** Acronym for *Metallic Oxide Semiconductor*.

**MOSFET** Acronym for *Metallic Oxide Semiconductor Field Effect Transistor*, a semiconductor characterized by an extremely high input impedance, a fairly high active impedance, and low switching speeds. When a voltage (negative with respect to the substrate) is applied to the *gate*, the MOSFET is a conductor; if a potential difference is applied between *source* and *drain*, there will be current flow.

**MOS/LSI** See *metallic oxide semiconductor and large scale integration*.

**most significant digit (MSD)** That digit of a number that has the greatest weight or significance. In the number 58371, the most significant digit is 5. See *high-order* and *justify*.

**motherboard** Interconnecting assembly into which printed circuit cards, boards, or modules are connected. Main circuit board of a microcomputer. Also called *system board* and *backplane*.



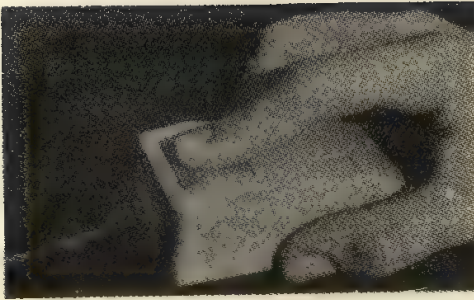
**Motorola** Manufacturer of electronic equipment, including microprocessors.

**mouse** Device for moving a cursor or other object around on the display screen. A typical mouse has one or more buttons on top of a small box that can be moved around on a flat surface. The box is connected to the computer with a taillike cord. As the mouse moves, the cursor moves correspondingly on the screen, the buttons being used for specific actions. The mouse's main advantage is that it can move a cursor around on the screen, including diagonally, with great precision. Compare *track ball*.

**mouse button** Switch on top of the *mouse* that transmits commands to the computer. See *click* and *double-click*.

**movable-head disk unit** Storage device or system consisting of magnetically coated disks, on the surface of which data are stored in the





Mouse

form of magnetic spots arranged in a manner to represent binary data. The data are arranged in circular tracks around the disks and is accessible to reading and writing heads on arms that can be moved mechanically to the desired tracks on the disks. Data from a given track are read or written sequentially as the disk rotates. Contrast with *fixed-head disk unit*.

**move** (1) To transfer (copy) data from one location of storage to another location. (2) In computer graphics, to change the current position on a graphics coordinate system.

**moving average** Method of averaging out the roughness of random variation in a data series. Uses only the most recent historical data in the series. The method gets its name from the way it slides along the data series, averaging each data point with its immediate predecessors. The average may disclose trends that would otherwise be obscured by the minor fluctuations along a line.

**MP/M** Acronym for Multiprogramming control Program for Microcomputers, a multiuser operating system for small computers. MP/M is a CP/M variant.

**MPU** Acronym for MicroProcessing Unit. See *microprocessor*.

**MPX** Acronym for *MultiPlexer*.

**ms** Abbreviation of millisecond. Also msec.

**MSD** Acronym for *Most Significant Digit*.

**MS-DOS** Acronym for MicroSoft Disk Opera-

ting System, the standard operating system used by IBM PC-compatible computers. See CP/M and UNIX.

**MSI** Acronym for *Medium Scale Integration*.

**M68000** Sixteen-bit microprocessor chip manufactured by Motorola. Developed especially for use in microcomputers.

**MSSG** Abbreviation of message

**MSX** Standard developed by Microsoft Corporation that the Japanese are using to help unify the home computer market. MSX computers are used throughout Japan.

**MTBF** Acronym for Mean Time Between Failures, the average length of time a system or component is expected to work without failure.

**MTTF** Acronym for Mean Time To Failure, the average length of time in which the system, or a component of the system, works without fault.

**MTTR** Acronym for Mean Time To Repair, the average time expected to be required to detect and correct a fault in a computer system.

**mu** Name of the Greek letter  $\mu$ , the symbol used to denote the prefix *micro*. For example,  $\mu$ s means microsecond.

**$\mu$ C** Abbreviation for microcomputer ( $\mu$  is the Greek letter *mu*).

**MUG** Acronym for MUMPS Users Group.

**multiaccess computer** Computer system in which computational and data resources are made available simultaneously to a number of users, who access the system through terminal devices, normally on an *interactive* or *conversational* basis. May consist of only a single central processor connected directly to a number of terminals (*star network*), or it may consist of a number of processing systems that are distributed and interconnected with one another (*ring network*) as well as with other terminals.

## multiaddress

**multiaddress** Pertaining to an instruction format containing more than one address part.

**multicomputer system** Computer system consisting of two or more central processing units.

**multidrop line** Communications system configuration that uses a single channel or line to service several terminals. Also called *multi-point line*. Contrast with *point-to-point line*.

**multifile sorting** Automatic sequencing of more than one file, based upon separate parameters for each file, without operator intervention.

**multifunction board** Device that plugs into computers, giving the system more than one new capability, such as a clock/calendar, memory expansion board or parallel/serial interface.

**multijob operation** Concurrent execution of job steps from two or more jobs. Compare *multiprogramming*.

**multilayer** Type of printed circuit board that has several circuit layers connected by electroplated holes.

**multilevel addressing** See *indirect addressing*.

**multilinked list** List with each atom having at least two *pointers*.

**multipass** Process of running through the same data more than once to accomplish a task too complicated to be accomplished in one pass.

**multipass sort** Sort program designed to sort more data than can be contained within the internal memory of a central computer. Intermediate storage, such as disk, tape, or drum, is required. See *internal sort* and *external sort*.

**multiple-access network** Flexible system by which every station can have access to the network at all times; provisions are made for

times when two computers decide to transmit at the same time.

**multiple-address instruction** Instruction consisting of an operation code and two or more addresses. Usually specified as a *two-address*, *three-address*, or *four-address instruction*. See *two-address computer* and *three-address computer*. Contrast with *one-address instruction*.

**multiple-address message** Message to be delivered to more than one destination.

**multiple connector** Connector to indicate the merging of several lines of flow into one line, or the dispersal of one line of flow into several lines.

**multiple-job processing** Controlling the performance of more than one data processing job at a time.

**multiple-pass printing** Technique used on some dot matrix printers to obtain higher-quality characters. The print head makes one pass, the paper is moved slightly, and another pass is made. The end product is a printed character that is easier to read. Contrast with *shadow printing*.

**multiple punching** Punching of two or more holes in a card column.

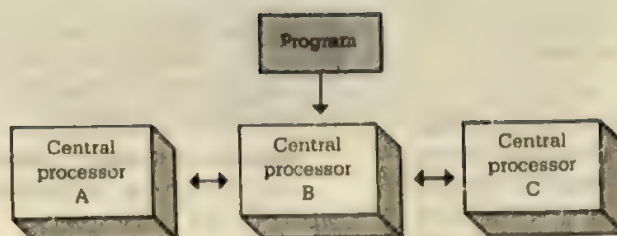
**multiple regression** Statistical technique for predicting the value of a "dependent variable" that is assumed to be dependent upon one or more explanatory or "independent variables."

**multiple user system** Computer system designed to allow more than one user on the system at a time.

**multiplex** To interleave or simultaneously transmit two or more messages over a single channel or other communications facility.

**multiplexer (MPX)** Device that allows several communications lines to share one computer data channel. Also abbreviated MUX. See





Multiprocessing

*concentrator and time-division multiplexer. Contrast with demultiplexer.*

**multiplexer channel** Special type of input/output channel that can transmit data between a computer and a number of simultaneously operating peripheral devices. Contrast with *selector channel*

**multiplexor** Alternate spelling of *multiplexer*.

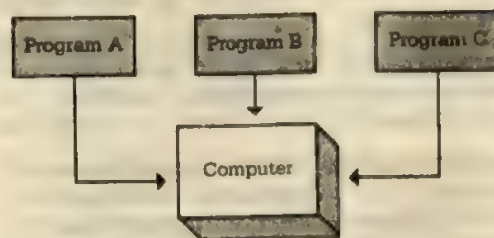
**multiplication time** Time required to perform a multiplication. For a binary number, it will equal the total of all the addition times and all the shift time involved in the multiplication.

**multiprecision arithmetic** Form of arithmetic in which two or more computer words are used to represent each number.

**multiprocessing** Simultaneous execution of two or more sequences of instructions by multiple central processing units under common control. Contrast with *multiprogramming*.

**multiprocessor** Computer network consisting of two or more central processors under a common control.

**multiprogramming** Running two or more programs concurrently in the same computer. Each program is allotted its own place in memory and its own peripherals, but all share the central processing unit. It is made economical by the fact that peripherals are slower than the CPU, so most programs spend most of their time waiting for input or output to finish. While one program is waiting, another can use the CPU. See *I/O bound* and *overlap*.



Multiprogramming

**multi-reel sorting** Automatic sequencing of a file having more than one input tape, without operator intervention.

**multistar network** Data communications network in which several host computers are connected, and each host computer has its own *star network* of smaller computers

**multisystem network** Communications network with two or more host computers. Enables a terminal to select the computer with which it wishes to communicate.

**multitasking** Ability of a computer to perform two or more tasks simultaneously.

**multitask operation** Two or more segments within a program running in one computer at the same time

**multiuser** Pertaining to a computer system that contains two or more user terminals that can be used concurrently.

**multiviewports** Screen display that shows two or more viewing screens that are adjacent but independent.

**multivolume file**

**multivolume file** File so large that it requires more than one disk pack, reel, or magnetic tape to hold it.

**MUMPS** Acronym for Massachusetts General Hospital Utility Multi-Programming System, a programming language designed specifically for handling medical records. The language is strong in data management and text manipulation features.

**$\mu$ P** Abbreviation for microprocessor ( $\mu$  is the Greek letter *mu*).

**$\mu$ s** Abbreviation for microsecond; one millionth of a second ( $\mu$  is the Greek letter *mu*). Same as  $\mu$ sec.

**musical language** Method by which musical notation may be represented in code suitable for computer input. See *computer music*.

**musicomp** Compositional programming language that provides techniques for generating original musical scores as well as for synthesizing music.

**music synthesizer** Device that can be linked to a computer for recording music, playing music, and so on.

**MUX** Acronym for *MUltipleXer*.

**MVT** Acronym for Multiprogramming with a Variable number of Tasks, the tasks being programs (Also jokingly called Multiprogramming with a Vast amount of Trouble.) Contrast with *MFT*

**mylar** DuPont trademark for polyester film, often used as a base for magnetically coated or perforated information media, such as *magnetic tape*.



# N

**naive user** Person who wants to do something with a computer but does not have the experience needed to program the computer. Compare *geek* and *nerd*.

**NAK** International transmission control code returned by a receiving terminal to signify that a frame of information has been received but is incorrect. Contrast with *ACK*.

**name** Alphanumeric term that identifies a program, a control statement, data areas, or a cataloged procedure. Same as *label*.

**NAND** Logical operator having the property that, if P is a statement, Q is a statement, then the NAND of P, Q, . . . is true if at least one statement is false and false if all statements are true. Combination of NOT-AND. Compare *AND*, *OR*, *NOR*, and *XOR*.

**nano** Prefix meaning one billionth. Contrast with *giga*, one billion.

**nanacre** One billionth of an acre, used figuratively to describe the area of an integrated circuit.

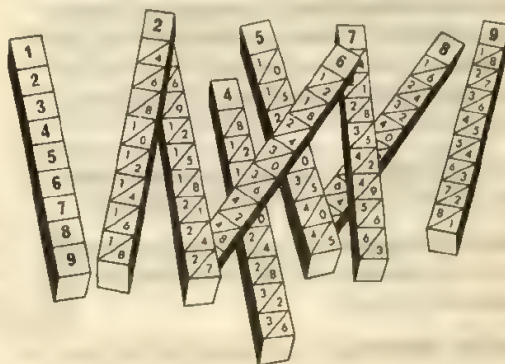
**nanocomputer** Computer capable of processing data in billionths of a second. Compare *picocomputer*.

**nanosecond** One billionth of a second; one thousand-millionth of a second; abbreviated ns. Same as millimicrosecond. Light travels approximately one foot per nanosecond, electricity slightly less. The most powerful computers now being manufactured can carry out an instruction in less than a nanosecond. That is, such a machine can execute more than one

billion instructions in one second!

**Napier, John** (1550–1617) Scottish aristocrat who made many contributions to mathematics and computing. Invented logarithms and a calculating device known as *Napier's bones*.

**Napier's bones** Set of numbering rods used to multiply, divide, and extract roots. The calculating rods were developed by John Napier in 1614 and used by William Oughtred in 1630 in the invention of the slide rule.



Napier's bones

**narrowband** Pertains to a data communications system that handles low volumes of data at a low range of frequencies. Contrast with *broadband* and *voice-grade*.

**NASA** Acronym for National Aeronautics and Space Administration.

**National Computer Conference (NCC)** Annual meeting of computer users, computer science educators, software developers, and computer equipment manufacturers, sponsored

## National Computer Graphic Association (NCGA)

by the *American Federation of Information Processing Societies*.

**National Computer Graphics Association (NCGA)** Nonprofit organization dedicated to developing, promoting, and improving computer graphics applications in business, government, science, and the arts. NCGA brings together users and producers of computer graphics technology in a common, independent forum to share experience and knowledge. This exchange of ideas and viewpoints between the computer graphics industry and the creative people it serves identifies potential applications and spurs development of new technology.

**National Crime Information Center (NCIC)** FBI's computerized network of data related to crimes that have occurred throughout the United States. May be accessed by law enforcement agencies at all government levels.

**National Educational Computing Conference (NECC)** Annual meeting of educators interested in the use of computers in education. See *World Conference on Computers in Education*.

**native compiler** Compiler that produces code usable only for a particular computer.

**native language** Computer language peculiar to the machines of one manufacturer. See *machine language*.

**natural language** Language that allows users to prepare programs in an English-like or other natural language. See *query language*. Contrast with *artificial language*.

**NBS** Acronym for National Bureau of Standards, a government agency responsible for establishing standards for the computer industry.

**NCC** Acronym for *National Computer Conference*, a large computer trade show held annually.

**NCGA** Acronym for *National Computer Graphics Association*.

**N-channel MOS (NMOS)** Circuit that uses current made up of negative charges. Has at least twice the speed but lower density than *PMOS*.

**NCIC** Acronym for the FBI's computerized *National Crime Information Center*, the heart of a large law enforcement network.

**NCR Corporation** Large manufacturer of computer equipment.

**NDBMS** Acronym for *network database management system*.

**NDRO** Acronym for NonDestructive ReadOut. See *nondestructive read*.

**near letter quality** Pertaining to output produced by some printers (dot matrix) that does not look as readable as that produced by a *letter-quality printer*.

**NECC** Acronym for the *National Educational Computing Conference*.

**negate** To perform the logical operator NOT.

**negative true logic** System of logic in which a high voltage represents the bit value 0 and a low voltage represents the bit value 1.

**negotiation** Art of exchanging services or commitments in an effort to agree on a mutually satisfactory contractual relationship

**NELIAC** Acronym for Naval Electronics Laboratory International Algorithmic Compiler, a high-level programming language used primarily for solving scientific and real-time control problems.

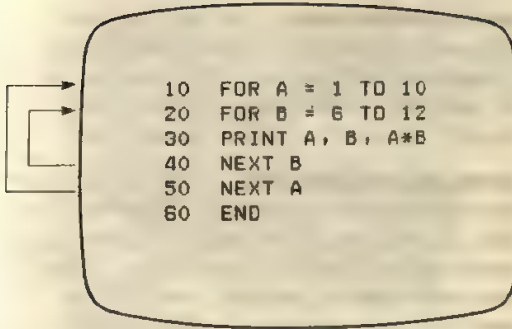
**nerd** Computer amateur. See *geek*.

**nest** To insert a command between the beginning and end of another command.

**nested block** Program block inside another program block.

**nested loop** Loop that is contained within another *loop*.





Nested loop

**nested subroutine** Subroutine reached by a subroutine calling statement (such as GOSUB in the BASIC language) in another *subroutine*.

**nesting** Embedding program segments or blocks of data within other program segments or blocks of data. Algebraic nesting involves grouping expressions within parentheses, such as  $(W * X * (A - B))$ .

**network** (1) System of interconnected computer systems and terminals. See *local area network*, *ring network*, and *star network*. (2) Series of points connected by communications channels. (3) Structure of relationships among a project's activities, tasks, and events.

**network analysis** Listing of the components of a project network, with their start/end dates and *float* and *dependency* parameters.

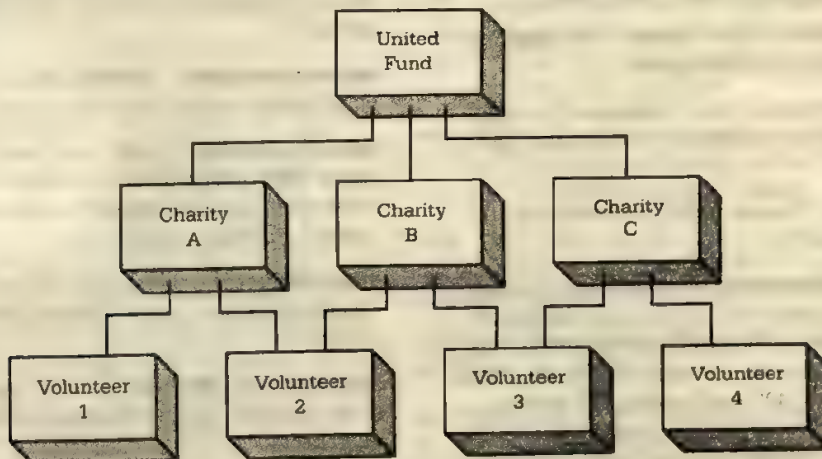
**network chart** Chart that depicts time estimates and activity relationships.

**network database management system (NDBMS)** Collection of related programs for loading, accessing, and controlling a database. Data records are linked by a complex system of pointers that frequently must be updated. Contrast with *hierarchical database management system* and *relational database management system*.

**networking** (1) Technique for distributing data processing functions through communications facilities. (2) Design of networks.

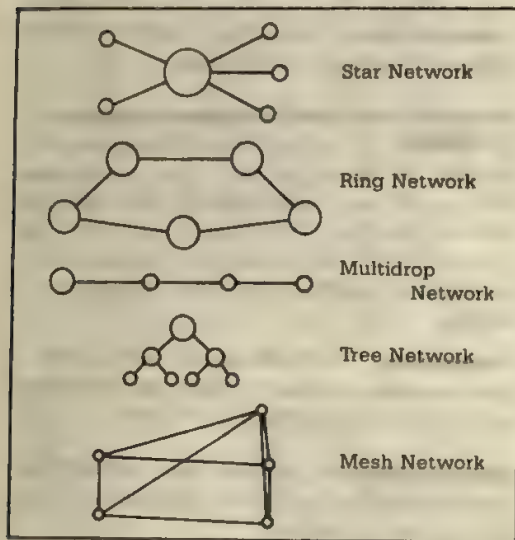
**network theory** Systematizing and generalizing of the relationships among the elements of an electrical network.

**network topologies** Physical arrangements of nodes and interconnecting communication links in networks based on application requirements and geographical distribution of users. Patterns include *star network*, *ring network*, *multidrop network*, *tree network*, and *mesh*.



Network database structure

**network.** In practice, most networks are made up of some combination of these topologies.



Network topologies

**neural net** Mathematical model of some phenomenon associated with neuronal behavior.

**Newton-Raphson** Interactive procedure used for solving equations. See *iterate*.

**nibble** Half of a *byte*, namely, four adjacent bits. Sometimes spelled nybble.

**niladic** Pertaining to an operation for which no operands are specified. Contrast with *monadic*.

**nil pointer** Pointer used to denote the end of a linked list.

**nine's complement** Numeral used to represent the negative of a given value. Obtained by subtracting each digit from a numeral containing all nines; for example, 567 is the nine's complement of 432 and is obtained by subtracting 432 from 999. Compare *one's complement*, *two's complement*, and *ten's complement*.

**ninety-column card** Punched card used with early UNIVAC card-handling equipment. Contains 90 columns, and one character can be punched in each column. Contrast with *Hollerith card* and *ninety-six-column card*.

**ninety-six column card** Punched card used with card-handling equipment. Physically contains 18 rows and 36 columns, and three characters can be punched in each column. Contrast with *Hollerith card* and *ninety-column card*.

**nixie tube** Vacuum tube used to display legible numbers. See *numerical indicator tube*.

**NMOS** Acronym for *N-channel MOS*.

**node** (1) Any terminal, station, or communications computer in a computer network. (2) Point in a *tree structure* where two or more branches come together. (3) Connecting point on a component, printed circuit board, or logic element where electrical connections can be made.

**noise** (1) Loosely, any disturbance tending to interfere with the normal operation of a device or system, including those attributable to equipment components, natural disturbance, or manual interference. (2) Spurious signals that can introduce errors. (3) Any unwanted signal.

**noise immunity** Device's ability to accept valid signals while rejecting unwanted signals.

**noise pollution** Noise, especially office noise, that distracts and cuts into productive work time, such as noise from printers, typewriters, and copy machines.

**nonconductor** Substance through which electricity cannot pass. Contrast with *semiconductor*.

**nondestructive read** Read operation that does not alter the information content of the storage media.

**nonerasable storage** Storage device whose



information cannot be erased during the course of computation, such as punched paper tape, punched cards, and certain nondestructible readout magnetic memories.

**nonexecutable statement** Program statement that sets up a program but does not call for any specific action on the part of the program in which it appears. Contrast with *executable statement*.

**nongraphic character** Character that, when set for a printer or display unit, does not produce a printable character image, such as carriage control and upper case

**nonimpact printer** Printer that uses electricity, heat, laser technology, or photographic techniques to print output. See *electrostatic printer*, *laser printer*, and *thermal printer*. Contrast with *impact printer*.

**nonlinear programming** Area of applied mathematics concerned with finding the values of the variables that give the smallest or largest value of a specified function in the class of all variables satisfying prescribed conditions. Contrast with *linear programming*.

**nonnumeric programming** Programming that deals with symbols rather than numbers. Usually refers to the manipulation of symbolic objects, such as words, rather than the performance of numerical calculations

**nonoverlap processing** Technique whereby reading, writing, and internal processing occur only in a serial manner. Contrast with *overlap processing*

**nonprint** Pertaining to an impulse that inhibits line printing under machine control.

**nonprocedural query language** Computer language for interacting with a database. It specifies what the user wants to know rather than the steps needed to produce the information, which are worked out by the computer. For example, on some systems the user fills out a screen showing a blank record with ranges of

values desired for selected fields. See *query language*.

**nonreflective ink** Any color of ink recognizable to an optical character reader. Also called *read ink*

**nonsequential computer** Computer that must be directed to the location of each instruction.

**nonswitched line** Communications link permanently installed between two points. Also called *leased line*.

**nonvolatile storage** Storage medium that retains its data in the absence of power, such as *magnetic bubble memory* and *magnetic core storage*. Contrast with *volatile storage*.

**no-op (NOP)** Abbreviation of no-operation, as in *no-operation instruction*.

**no-operation instruction** Computer instruction whose only effect is to advance the instruction counter. Accomplishes nothing more than to advance itself to the next instruction in normal sequence.

**NOP** Acronym for No-Operation. See *no-operation instruction*.

**NOR** Boolean operator that gives a truth table value of true only when both of the variables connected by the logical operator are false. Compare *AND*, *OR*, and *XOR*

**normalize** To adjust the exponent and fraction of a floating-point quantity so the fraction is within a prescribed range. Loosely, to *scale*.

**NOT** Logic operator having the property that, if P is a statement, then the NOT of P is true if P is false and false if P is true

**notation** See *Polish notation* and *positional notation*.

**notebook computer** Briefcase-sized computer that uses a flat panel liquid crystal display. Larger than a *hand-held computer* but smaller than a *portable computer*.

## NOT gate

**NOT gate** Circuit equivalent to the logical operation of negation.

**NOVA** Designation for computers manufactured by the Data General Corporation.

**Noyce, Robert** Developer, with Jean Hoerni, of the planar process, in which circuit components are interconnected by photoengraving on a flat, polished wafer, usually silicon, at Fairfield Semiconductor in 1959. See *Kilby, Jack*.

**NRZ** Acronym for NonReturn to Zero, one of several methods for coding digital information on magnetic tape.

**ns** Abbreviation for *nanosecond*, one billionth of a second.

**NTSC** Acronym for National Television System Committee, a color television standard.

**nucleus** That portion of the *control program* that must always be present in internal storage.

**null** Pertaining to a negligible value or a lack of information, as contrasted with a zero or a blank that conveys information, such as a numerical value and a space between words. Empty.

**null cycle** Time required to cycle through an entire program without introducing new data.

**null string** String with no characters. Also called empty string.

**number** (1) Symbol or symbols representing a value in a specific numeral system. (2) Loosely, a *numeral*.

**number base** See *radix*.

**number cruncher** Program or computer designed to perform large amounts of computation and other numerical manipulations of data. See *supercomputer*.

**number representation** Representation of numbers by agreed sets of symbols according to agreed rules.

**number system** Agreed set of symbols and

rules for number representation. Loosely, a *numeral system*.

**numeral** Conventional symbol representing a number; for example, 6, VI, and 110 are different numerals that represent the same number in different *numeral systems*.

**numeralization** Representation of alphabetic data through the use of digits.

**numeral system** Method of representing numbers. In computing, several numeral systems, in addition to the common decimal system, are of particular interest: the binary, hexadecimal, and octal systems. In each system, the value of a numeral is the value of the digits multiplied by the numeral system *radix*, raised to a power indicated by the position of the digits in the numeral. See *positional notation*.

**numeric** Pertaining to numerals or to representation by means of numerals. Compare *alphanumeric*.

**numerical analysis** Branch of mathematics concerned with the study and development of effective procedures for computing answers to problems.

**numerical control** Method of controlling machine tools through servomechanisms and control circuitry so the motions of the tools will respond to digital coded instructions on tape or to direct commands from a computer. See *APT*, *DNC*, and *parts programmer*.

**numerical indicator tube** Any electron tube capable of visually displaying numerical figures. See *nixie tube*.

**numeric character** Same as *digit*.

**numeric coding** Coding that uses only digits to represent data and instructions.

**numeric constant** Data using integers or real numbers. See *constant*.

**numeric data** Data that consists entirely of numbers.

**numeric keypad** See *keypad*.



# O

**oasis** Multiuser operating system used on several microcomputer systems.

**obey** Process whereby a computer carries out an operation as specified by one or more of the instructions forming the program currently being executed.

**object code** Output from a compiler or assembler that is itself executable machine code or is suitable for further processing to produce executable machine code. Also called *object program*.

**object computer** Computer used for the execution of an object program.

**object deck** Set of punched cards representing the machine-language equivalent of a *source deck*.

**object language** Output of a translation process. Usually, object language and machine language are the same. Synonymous with *target language*. Contrast with *source language*.

## object language programming

Programming in a machine language executable on a particular computer.

## object-oriented programming

Programming approach centered around a collection of data objects, each knowing how to respond to a set of commands that can be given to it.

**object program** Instructions that come out of the *compiler* or *assembler*, ready to run on the computer. Also called *object code* and *target program*. Contrast with *source program*.

**OCR** Acronym for *Optical Character Recognition*.

**octal** Pertaining to a number system with a radix of 8. Octal numerals are frequently used to represent binary numerals, with each octal digit representing a group of three binary digits (bits); for example, the binary numeral 111000010001101 can be represented as octal 70215. See *binary-to-octal conversion*.

**octal numeral** Numeral of one or more digits, expressing a sum in which the quantity represented by each figure is based on a radix of 8. The digits used in octal numerals are 0, 1, 2, 3, 4, 5, 6, and 7.

Binary groups	Octal digit
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

Octal numeral

**octal point** Radix point in a mixed octal numeral, separating the fractional part from the integer part. In the octal numeral 72.24, the octal point is between the 2s.

**octet** Byte composed of eight bits.

**OEM** Acronym for *Original Equipment Manu-*

**facturer**, a company or organization that purchases computers and peripheral equipment for use as components in products and equipment that they subsequently sell to their customers.

**office automation** Application of computers and communications technology to improve the productivity of clerical and managerial office workers.

**office computer** Usually, a microcomputer system for use in an office environment. Likely to include disk units, a printer, and software developed for specific office functions.

**office information system** System that can include a variety of data entry terminals, word processors, graphics terminals, printers, and computer systems.

**office of the future** Office that makes extensive use of computers, data communications, and other electronic technologies. In such an office, numerous clerical, secretarial, and communications tasks are done automatically.

**offline** Pertaining to equipment, devices, or persons not in direct communication with the central processing unit of a computer. Equipment not connected to the computer. Contrast with *online*.

**offline storage** Storage not under control of the central processing unit.

**offload** (1) To transfer jobs from one computer system to another that is more lightly loaded. (2) To output data to a peripheral device.

**offpage connector** Pentagonal symbol used on a flowchart to link a line of flow on one page with its continuation on a different page.

**offset** Difference between the value or condition desired and that actually attained.

**off-the-shelf** Pertaining to any standard, mass-produced hardware or software product readily available from the vendor.

**OMR** See *optical mark recognition*.

**on-board computer** Computer resident in a

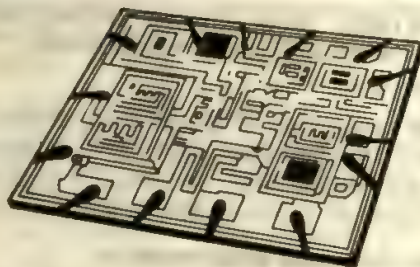
vehicle, such as a spacecraft, an automobile, a ship, or an aircraft.

**on-board regulation** Arrangement in which each board in a system contains its own voltage regulator.

**one-address computer** Computer that employs only one address in its instruction format. For example, in the instruction "ADD X," X represents the address in the instruction. Contrast with *two-address computer* and *three-address computer*. Compare *four-address instruction*.

**one-address instruction** Instruction consisting of an operation and exactly one address. In special cases, the instruction code of a single-address computer may include both zero and multiaddress instructions. Most present-day computers are of the one-address-instruction type. See *one-address computer*.

**one-chip computer** Complete microcomputer that is implemented on a single chip. Also called *computer-on-a-chip*.



One-chip computer

**one-dimensional array** Array consisting of a single row or column of elements.

**one-for-one** (1) Phrase often associated with an assembler in which one source-language statement is converted to one machine-language instruction. (2) Most commonly used type of correspondence.

**one-level memory** Memory in which all stored items are accessed by a uniform mechanism.



**one-out-of-ten-code** In this code, a decimal digit is represented by ten binary digits, and only one of the binary digits is permitted to be a 1.

**one-pass compiler** Language processor that passes through a source language program one time and produces an object module.

**one's complement** Numeral used to represent the negative of a given value. A one's complement of a binary numeral is obtained by alternating the bit configuration of each bit in the numeral. For example, 01100101 is the one's complement of the binary numeral 10011010. Compare *two's complement*, *nine's complement*, and *ten's complement*.

**online** Pertaining to equipment, devices, and persons that are in direct communication with the central processing unit of a computer. Equipment physically connected to the computer. Contrast with *offline*.

**online database** Database that can be directly accessed by a user from a terminal, usually a visual display device.

**online fault-tolerant system** Computer system designed to function correctly in the presence of hardware failures.

**online problem solving** Teleprocessing application in which a number of users at remote terminals can concurrently use a computing system in solving problems online. Often, in this type of application, a dialogue or conversation is carried on between a user at a remote terminal and a program within the central computer system.

**online storage** Storage under control of the central processing unit.

**op** Contraction of *operation*.

**opacity** Pertaining to the ease with which light passes through a sheet of paper, making it more or less translucent.

**op-code** See *operation code*.

**Opel, John** In 1981, guided IBM Corporation

into the microcomputer business. Under his leadership, IBM developed the IBM Personal Computer.

**open** Process required to begin work with a file or document.

**open-ended** Capable of accepting the addition of new programs, instructions, subroutines, modifications, terms, or classifications without disturbing the original system.

**open file** File that can be accessed for reading, writing, or possibly both. Contrast with *closed file*.

**open shop** Operation of a computer facility in which most productive problem programming is performed by each problem originator rather than by a group of programming specialists. Contrast with *closed shop*.

**open subroutine** Subroutine inserted into a routine at each place it is used. Contrast with *closed subroutine*.

**operand** Data unit or equipment item that is operated upon. Usually identified by an address in an instruction. In "ADD 100 TO 400," 100 and 400 are operands. See *operation code*.

**operating ratio** See *availability*.

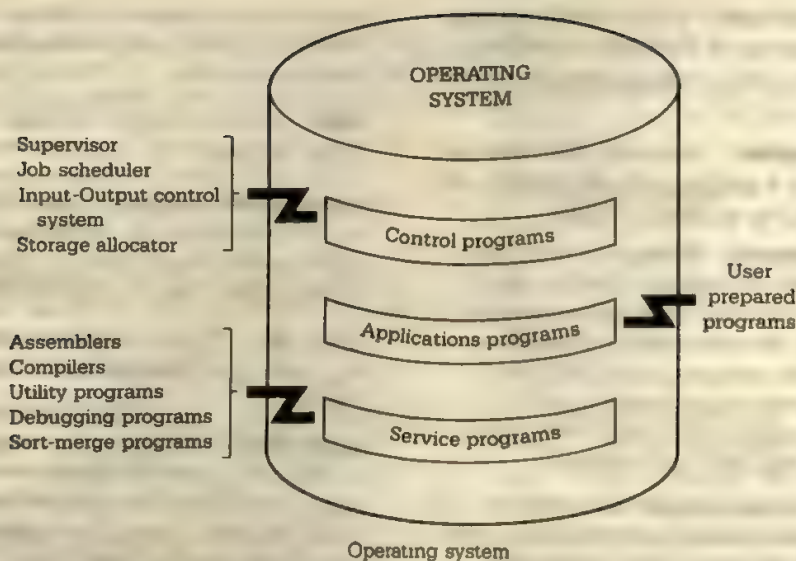
**operating system (OS)** Software that controls the execution of computer programs and that may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services. (See page 208.)

**operation** (1) Any defined action. (2) Action specified by a single computer instruction or high-level-language statement. Abbreviated *op*.

**operational management** Supervisors or leaders responsible for operating details and the employees who perform them.

**operation center** Physical area containing the human and equipment resources needed to process data through a computer and produce

operation code



desired output. Same as *data processing center*.

**operation code** Instruction code used to specify the operations a computer is to perform. In "ADD 100 TO 400," ADD is the operation code. See *operand*.

**operations analysis** Same as *operations research*.

**operations personnel** People responsible for controlling the equipment in a computer center. Operations personnel power up systems, load programs, run programs, report equipment malfunctions, and so on.

**operations research** Mathematical science devoted to carrying out complicated operations with the maximum possible efficiency. Includes such scientific techniques as *linear programming*, *probability theory*, *information theory*, *game theory*, *Monte Carlo method*, and *queuing theory*.

**operator** (1) In the description of a process, that which indicates the action to be performed on *operands*. See *arithmetic operator*. (2) Person who operates a machine. See *computer operator*.

**Optacon** Tradename for a device that allows blind people to "read" by translating impulses from a light beam into shapes of letters that the blind can feel on their skin.

**optical character** Character from a special set of characters that can be read by an optical character reader.

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y
Z	,	.	\$	/
1	2	3	4	5
6	7	8	9	0

Optical characters



**optical character reader** Input device that accepts a printed document as input, identifying characters by their shape. See *optical character recognition*.

**optical character recognition (OCR)**

Information processing technology that converts human-readable data in a special OCR font into another medium for computer input. Light reflected from characters is recognized by OCR equipment. Compare *optical mark recognition*.

**optical communications** Transmission of data, pictures, speech, or other information by light. An information-carrying light wave signal originates in a transmitter, passes through an optical channel, and enters a receiver, which reconstructs the original information. *Optical fibers* and *lasers* make up a technology that offers the maximum transmitting capacity using devices that occupy little physical space.

**optical disk** High-density storage device that uses a laser to burn a pattern of holes into a tellurium film on a disk surface. A single optical disk can hold billions of bytes of data. In fact, one optical disk storage system can store the entire *Encyclopedia Britannica* if necessary.

**optical fiber** Thread of highly transparent glass that is pulsed very rapidly to carry a stream of binary signals. As well as carrying a high volume of data, optical fibers are immune to the electrical interference that can plague conventional cables. The use of optical fibers is rapidly becoming standard in computer communications.

**optical laser disk** See *optical disk*.

**optical mark reader** Input device that reads graphite marks on cards or pages. See *mark sensing* and *optical mark recognition*.

**optical mark recognition (OMR)**

Information processing technology that converts data into another medium for computer input by the presence of a mark in a given

position, each position having a value known to the computer that may or may not be understandable to humans. See *mark sensing* and *optical mark reader*. Compare *optical character recognition*.

**optical page reader** Input device that accepts a page of printed matter.

**optical printer** See *electrostatic printer*.

**optical reader** See *optical character reader* and *optical mark reader*.

**optical reader wand** Device that reads bar codes and enters appropriate information into a computer. See *bar-code scanner*.

**optical recognition device** Device that can read symbols or marks coded on paper documents and can convert them into electrical pulses. See *optical character reader* and *optical mark reader*.

**optical scanner** See *optical character reader*.

**optical scanning** Any input method by which information is converted for machine processing by evaluating the relative reflectance of that information to the background on which it appears. See *optical character recognition*.

**optimal merge tree** Tree representation of the order in which strings are to be merged so that a minimum number of move operations occurs. Also called *minimal tree* and *Huffman tree*.

**optimization** In its most general meaning, the efforts and processes of making a decision, a design, or a system as nearly perfect, effective, or functional as possible.

**optimize** To write a program or design a system in such a way as to minimize or maximize the value of some parameter, especially cost, storage, and time.

**optimizing compiler** Compiler that attempts to correct inefficiencies in a program's

**optimum**

logic to improve execution times, main storage requirements, and so forth.

**optimum** Best and most desirable in view of established criteria.

**optimum programming** Programming to maximize efficiency with respect to some criterion, such as least storage usage, least usage of peripheral equipment, or least computing time.

**optimum tree search** Tree search whose object is to find the best of many alternatives.

**option key** Modifier key on some keyboards. When held down, it gives a different interpretation to characters next typed. Special control key.

**opto-electronics** Technology concerned with the integration of optics and electronics.

**OR** See *inclusive OR*.

**OR circuit** See *OR gate*.

**order** (1) To arrange items according to any specified set of rules. (2) Arrangement of items according to any specified set of rules. (3) Command found in most electronic spreadsheet programs that permits the user to determine the order of calculation.

**order of operations** Hierarchy of arithmetic operations whereby aggregation takes precedence, followed by exponentiation and extraction of roots, multiplication and division, then addition and subtraction.

**ordinate** Y axis of a graph or chart. Contrast with *abscissa*.

**organizational control** Personnel administrative procedures implemented to protect an information system from infiltration, tampering, or sabotage.

**organization chart** Diagram showing the organization of a business (how responsibilities are divided within the business). Pictorial representation of the organizational hierarchy, showing the formal relationships among em-

ployees of an organization.

**OR gate** Computer circuit containing two switches whose output is a binary 1 if either or both of the inputs are binary. Implements the OR operator. Contrast with *AND gate*.

**origin** In coding, the absolute memory address of the first location of a program or program segment.

**original data** Data to be processed. Also called *raw data*.

**original equipment manufacturer (OEM)** Manufacturer who buys equipment from other suppliers and integrates it into a single system for resale. See *OEM*.

**originate/answer** Pertaining to a modem that can both originate and answer messages. Most telecomputing services are in *answer mode*, so the user must be in *originate mode*.

**OR operator** Logical operator having the property that if *P* is a statement and *Q* is a statement, then the OR of *P*+*Q* is true if and only if at least one is true. false if all are false.

**orphan** First line of a paragraph sitting alone at the bottom of a page of text. Considered undesirable in all forms of printing. Compare *widow*.

**orthoferrite** Naturally occurring substance composed of alternate, snakelike regions of opposite magnetic polarity. Used as a substrate for *magnetic bubble memory*.

**orthographic** Type of layout, drawing, or map in which the projecting lines are perpendicular to the plane of the drawing or map.

**OS** Acronym for *Operating System*.

**oscillating sort** External tape sort that capitalizes on a tape drive's ability to read forward and backward.

**oscillography** Projection of a pattern of electrical signals on the face of a cathode ray tube.



**oscilloscope** Electronic instrument that produces a luminous plot on a fluorescent screen, showing the relationship of two or more variables. Used by computer maintenance technicians.

**Oughtred, William** (1575–1660) English mathematician who invented the slide rule in 1630. See *Napier's bones*.

**outdegree** Number of directed edges leaving a node. Contrast with *indegree*.

**outdent** In word processing, a line of text that extends farther to the left than other lines in the same paragraph. Opposite of *indentation*.

**out-of-line** Pertaining to statements in a computer program that are not in the main line of the program, such as *closed subroutines*.

**output** (1) Data transferred from a computer's internal storage unit to some storage or output device. (2) Final result of data that have been processed by the computer. Contrast with *input*.

**output area** Area of main storage reserved for output data. Contrast with *input area*.

**output buffer** Buffer used to transfer data to an external device.

**output channel** Channel that connects peripheral units and the central processing unit, and through which data may be transmitted for output.

**output data** Data to be delivered from a device or program, usually after some processing. Synonymous with *output*. Contrast with *input data*.

**output device** Unit used for taking out data values from a computer and presenting them in the desired form to the user, such as a *computer output microfilm recorder*, *digital plotter*, *printer*, and *video display terminal*. Contrast with *input device*.

**output media** Physical substance upon

which output information is recorded, such as paper, magnetic disk, or magnetic tape. Compare *input media* and *source media*.

**output stream** Sequence of data to be transmitted to an output device.

**outputting** Process of producing useful information output.

**overflow** In an arithmetic operation, the generation of a quantity beyond the capacity of the register or storage location that is to receive the result.

**overhead** (1) Collective term for the factors that cause the performance of a program or device to be lower than it would be in the ideal case. (2) Nonproductive effort that takes place when the operating system and programs are performing administrative tasks rather than productive work.

**overlap** To do something at the same time that something else is being done; for example, to perform an input operation while instructions are being executed by the central processing unit. This approach permits the computer to work on several programs at once. See *multiprogramming*.

**overlapping** Condition in which windows on a screen display are on top of one another, or overlap the borders of each other.

**overlap processing** Simultaneous execution of input, processing, and output activities by a computer system. Contrast with *nonoverlap processing*.

**overlay** To transfer segments of a program from auxiliary storage into internal storage for execution so that two or more segments occupy the same storage locations at different times. Technique used to increase the apparent size of internal storage by keeping only the programs or data that are currently being accessed within internal storage; the rest is kept on a direct storage device (magnetic disk unit) until needed.

## overprint

**overprint** Process of printing more than once at the same position in order to emphasize or improve the type. See *overstriking*.

**overpunch** To add holes in a card column that already contains one or more holes.

**override** To force a preexisting value to change in a program by superseding it.

**overrun** Condition that occurs when data is transferred to or from a nonbuffered control unit with a synchronous medium and the activity initiated by the program exceeds the channel capacity.

**overscan** Loss of text at the end of a line if the computer and monitor are not matched properly.

**overstriking** Ability of a hard-copy printer to strike a character more than once to produce a boldface effect on the printed copy. See *shadow printing* and *typeover*.

**overwrite** To place data in a location and destroy or mutilate the data previously contained in that location.



# P

**PABX** Acronym for *Private Automated Branch exchange*.

**pack** To store several short units of data into a single storage cell in such a way that the individual units can later be recovered; for example, to store two 4-bit BCD digits in one 8-bit storage location. Opposite of *unpack*.

**package** Program or collection of programs to be used by more than one business organization.

**packaged software** Software sold by a vendor (hardware manufacturer or a *software house*) in the form of a prepared *package* consisting of the program(s), documentation such as flowcharts and users' manuals, and perhaps test data with which to demonstrate the correct operation of the program after it is installed in the client's computer.

**packet** Block of data for data transmission. Contains control information—such as routing, address, and error control—as well as data.

**packing** Process of storing two numbers in a single storage byte.

**packing density** Number of useful storage cells per unit of area or length, such as the number of characters per inch. Also called *recording density*.

**pad** (1) Area of plated copper on a printed circuit board that provides a contact for soldering component leads, means of copper-path transition from one side of the printed circuit board to the other, and contact for test probes. (2) To fill a data field with blanks.

**pad character** Buffer character used to fill a blank.

**padding** Technique used to fill out a fixed-length block of information with dummy characters, items, words, or records.

**paddle** Hand-held device for making a display terminal cursor move either up or down or right or left by turning a dial on the paddle. Connected to the computer by a cable, it is used in computer graphics and for playing video games. Compare *joystick* and *mouse*.

**page** (1) Segment of a program or data; usually of fixed length, that has a fixed virtual address but can, in fact, reside in any region of the computer's internal storage. See *virtual storage*. (2) Amount of text or graphic material displayed on a screen at one time. See *paging*.

**page frame** Location in the rear storage of the computer that can store one page (which usually consists of either 2K or 4K words) of commands or data.

**page-in** Process of swapping programs or data from disk storage to the computer's main storage.

**page-out** Process of swapping programs or data from the computer's main storage to disk storage.

**page printer** Printer in which an entire page of characters is composed and determined within the device prior to printing. Some can print more than 20 000 lines per minute.

**page reader** Piece of optical scanning equipment that scans many lines of informa-

## page skip

tion, with the scanning pattern being determined by program control and/or control symbols intermixed with input data.

**page skip** Control character that causes a printer to skip the rest of the current page and move to the top of the next page

**pagination** (1) Electronic manipulation of graphics and blocks of type for the purpose of setting up an entire page. (2) Breakup of a printed report into units that correspond to pages. (3) Process of numbering pages

**paging** (1) Technique for moving programs back and forth from real (main) storage to virtual (auxiliary) storage. (2) In many video display terminals, a keyboard operation by which the displayed page is replaced by the following or preceding page. Compare *scrolling*

**paging rate** In virtual storage systems, the average number of page-ins and page-outs per unit of time

**paintbrush** Capability found in several computer graphics systems that provides the user with a variety of brush shapes and is used by

moving the mouse pointer on the display screen. See *brush*.

**painting** (1) Displaying the trail of movements of a graphical input device. (2) In computer graphics, filling a selected area with a solid color. (3) Process of displaying graphic data on a visual display screen

**PAL** Acronym for Phase Alternation Line, the color television system used in most European countries

**palette** Set of available colors in a computer graphics system

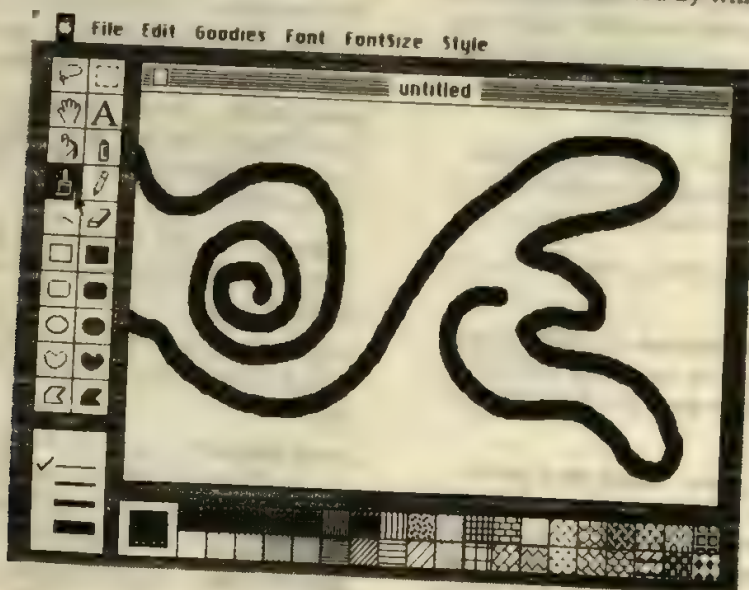
**PAM** Acronym for Pulse Amplitude Modulation, in which the modulation wave is caused to amplitude-modulate a pulse carrier

**pane** Term for each of the windows that result from splitting a single window.

**panel** See *control panel* and *plugboard*

**panning** Horizontal movement of displayed graphic data across a visual display screen

**paper feed** Method by which paper is pulled



Paintbrush



through a printer. See *friction-feed* and *tractor-feed mechanism*.

**paper tape** Continuous strip of paper in which holes are punched to record numerical and alphanumerical information for computer processing. For example, 8-track paper tape is 2.54 cm (1 in.) wide, and a character is recorded by punching a code of up to eight holes across the width of the tape. Used in *numerical control* systems. Also widely used as an I/O medium in computer systems in China.

**paper tape code** System of coding used to relate the patterns of holes in paper tape to the alphanumeric characters they represent.

**paper tape punch** Code-sensitive output device that translates computer code into an external code on paper tape.

**paper tape reader** Input device used for translating the holes in a perforated paper roll into machine-processable form.

**parabola** Graphics curve that can be obtained by cutting a right circular cone by a plane parallel to one of the elements. May also be described as the path of a point which moves so that it remains equidistant from a fixed point and a fixed line.

**paradigm** Fundamental conception that underlies a possible complex structure. Central kernel within a concept. New paradigms result in new conceptions. Popular buzzword among computer designers; the original Greek word meant merely an example, or pattern.

**paragraph** Set of one or more COBOL sentences making up a logical processing entity and preceded by a paragraph header or name.

**paragraph assembly** Process in which a document is assembled on a word processor from paragraphs stored on disks.

**parallel** (1) Handling all the elements of a word or message simultaneously. Contrast with *serial*. (2) In computer graphics, it describes

lines or planes in a graphics file that are an equal distance apart at every corresponding point.

**parallel access** Process of obtaining information from, or placing information into, storage where the time required for such access is dependent on the simultaneous transfer of all elements of a word from a given storage location. Also called *direct access*. Contrast with *serial access*.

**parallel adder** Adder that performs its operations by bringing in all digits simultaneously from each of the quantities involved. Contrast with *serial adder*.

**parallel circuit** Electric circuit in which the elements, branches, or components are connected between two points with one of the two ends of each component connected to each other.

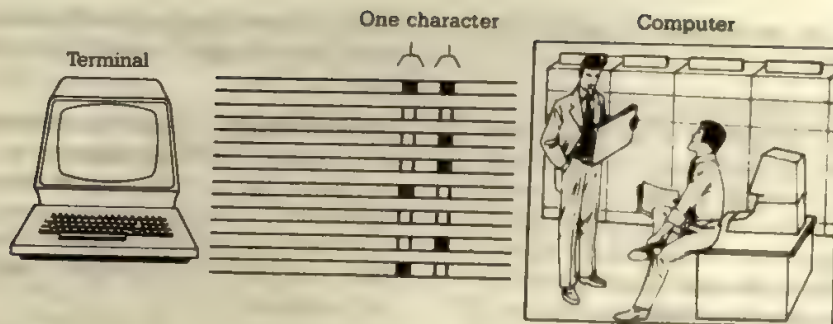
**parallel computer** Computer in which the digits or data lines are processed concurrently by separate units of the computer. Contrast with *serial computer*.

**parallel conversion** Process of changing to a new data processing system that involves running both the old and new systems simultaneously for a period of time. Also called *parallel run*. Contrast with *direct conversion*. Compare *phased conversion*.

**parallel input/output** Data transmission in which each bit has its own wire. All of the bits are transmitted simultaneously, as opposed to being sent one at a time (serially). Contrast with *serial input/output*.

**parallel interface** Equipment boundary where information is transferred simultaneously over a set of paths. Contrast with *serial interface*.

**parallel operation** Performance of several actions, usually of a similar nature, simultaneously through the provision of individual, similar, or identical devices for each such action. Contrast with *serial operation*.



Parallel transmission

**parallel printer** Printer that receives information from the computer one character (letter, number, etc.) at a time through eight wires. Additional wires are needed to exchange control signals. Contrast with *serial printer*.

**parallel printing** Printing an entire row at one time.

**parallel processing** Concurrent or simultaneous execution of two or more processes in multiple devices, such as processing units or channels. Contrast with *serial processing*.

**parallel reading** Row-by-row reading of a data card. Contrast with *serial reading*.

**parallel run** Process of running a new system or program in parallel with the old system to ensure a smooth transition and error-free conversion. Same as *parallel conversion*.

**parallel transmission** In data communications, a method of data transfer in which all bits of a character are set simultaneously. Contrast with *serial transmission*.

**parameter** (1) Any arbitrary constant, especially one characteristic or even definitive of a given system. (2) Variable in an algebraic expression that temporarily assumes the properties of a constant. For example, in  $y = mx + b$ ,  $m$  and  $b$  are parameters if either is treated as a constant in a family of lines.

**parametric** Pertaining to the technique by which a line, curve, or surface is defined by

equations based on some independent variable. Used often in *computer-aided design* systems

**parent** File whose contents are required, and in some cases are the only sources of information available, to create new records. See *child*

**parent/child relationship** Passing of information from one generation to the next. Older information (parent) is necessary to create new information (child).

**parentheses** Grouping symbol ( ). In arithmetic calculations, operations in parentheses are treated as entities with the highest priority. See *order of operations*.

**parity bit** Extra bit added to a byte, character, or word to ensure that there is always either an even number or an odd number of bits, according to the logic of the system. If, through a hardware failure, a bit should be lost in transmission, its loss can be detected by checking the parity. The same bit pattern remains as long as the contents of the byte, character, or word remain unchanged.

**parity checking** Automatic error detection by using checking bits along with the data bits. See *parity bit*.

**Parkinson's Law** The task expands to meet the time available for its completion.

**parser** Program or subroutine that analyzes and understands statements. See *Intellect*.



**parsing** (1) Process of separating statements into syntactic units. (2) Analyzing a character string and breaking it down into a group of more easily processed components.

**partition** Area in memory assigned to a program during its execution.

**partitioning** Subdividing a computer storage area into smaller units allocated to specific jobs or tasks.

**parts explosion** Drawing of all the pieces composing an assembly that illustrates the relation of the pieces to one another.

**parts list** Collection of the quantities, names, and numbers of all parts used to produce a manufactured item. Most CAD/CAM systems maintain and update such lists automatically during the course of a design and manufacturing process.

**parts programmer** Programmer who translates the physical explanation for machining a part into a series of mathematical steps and then codes computer instructions for those steps. See *APT* and *numerical control*.

**party-line** Used to indicate a large number of devices connected to a single line originating in the central processing unit.

**Pascal** High-level programming language that has gained wide acceptance as a tool for

```

program add (input, output);
var
  first, second, sum: integer;
begin
  read(first, second);
  sum := first + second;
  write (sum)
end

```

Pascal

both applications programming and system development. Has been implemented for computer systems ranging from microcomputers to mainframes. Relatively easy to use, yet more powerful than assembly language, FORTRAN, and BASIC. Provides a flexible set of control structures and data types to permit orderly, top-down program design and development. See *UCSD Pascal* and *Wirth, Niklaus*.

**Pascal, Blaise** (1623–1662) French mathematician who built the first desk-calculator-type adding machine in 1642. See *Pascal's calculator*.



Blaise Pascal

**Pascal's calculator** First desk-calculator-type adding machine, designed by Blaise Pascal in the seventeenth century. Represented the digits from 0 to 9 with teeth on gears and could perform addition and subtraction. See *Pascal, Blaise*. (See page 218.)

**pass** (1) Complete input, processing, and output cycle in the execution of a computer program. (2) Scanning of source code by a compiler or assembler.

**passive device** Device that passes signals without altering them.



Pascal's calculator

**passive graphics** Computer graphics operation that transpires automatically and without operator intervention.

**password** Special word, code, or symbol that must be presented to the computer system to gain access to its resources. Used for identification and security purposes on a computer system. Each user is assigned a specific set of alphanumeric characters to gain entrance to the entire computer system or to parts of the system. Also called *lock code*.

```
HELLO
WHAT IS THE PASSWORD? ABC 12345
WHAT IS YOUR NAME? BOB SMITH
WHAT IS YOUR BILLING NUMBER? R123
SYSTEM READY
```

Password

**paste** To place information previously cut from a document into a new position. With

some computer systems, areas of text or graphics may be cut from a document, saved, and later pasted into another document. See *cut-and-paste*.

**patch** (1) Section of coding inserted into a program to correct a mistake or to alter the program. (2) Temporary electrical connection. (3) In computer graphics, a piece of curvilinear surface, typically with three or four sides. These are attached together at their edges with at least first-order continuity to form complex 3-D surfaces. The edges of a patch are frequently described with polynomials or ratios of polynomials. For example, if both dimensions are described with cubic polynomials, then the patch is said to be bicubic. If ratios of cubic polynomials are used, then the patch is a rational bicubic patch. Although difficult to deal with, one patch can take the place of hundreds of flat polygons and thus greatly reduce the size of a database. (4) To modify a computer system by adding post-installation *enhancements*. Usually done by a *customer engineer*.

**patching** (1) Makeshift technique for modifying a program or correcting programming errors by changing the object code of the program, usually to avoid recompiling or reassembling the program. (2) Making temporary patches to hardware.

**path** Hierarchy of files through which control passes to find a particular file. See *channel*.

**pattern recognition** Recognition of forms, shapes, or configurations by automatic means.

**PC** Acronym for *Personal Computer*, *Pocket Computer*, *Portable Computer*, *Printed Circuit*, and *Program Counter*.

**PCB** Acronym for *Printed Circuit Board*, the plastic board into which a computer's various electronic components are soldered. These are linked by thin interconnecting wires printed on its surface.

**PC-DOS** *Disk operating system* for the IBM Personal Computer. Similar to *MS-DOS*.



**P-channel MOS (PMOS)** Relatively old *metallic oxide semiconductor* technology for *large scale integration* devices. See *PMOS*. Contrast with *N-channel MOS*.

**PCM** Acronym for Plug Compatible Manufacturer, a business that makes computer equipment that can be plugged into existing computer systems without requiring additional hardware or software interfaces.

**p-code** Method of translating a source code to an intermediate code, called p-code, by means of a compiler, then using a special p-code interpreter on a host machine to obtain an executable object code. Several versions of Pascal use p-code. See *p-system*.

**PDM** Acronym for Pulse Duration Modulation, pulse time modulation in which the duration of a pulse is varied. Contrast with *PAM* and *PPM*.

**PDP** Designation for computers manufactured by Digital Equipment Corporation, such as PDP-8, PDP-10, and PDP-11.

**PEEK** Computer-language instruction that allows the programmer to look at (peek at) any location in a computer's programmable memory. See *POKE*.

**peek-a-boo system** Method of checking the presence or absence of punched holes in identical locations on cards by placing one card on top of another. See *Batten system*.

**pel** Picture element. See *pixel*.

**pen plotter** See *plotter* and *drum plotter*. Contrast with *electrostatic plotter*.

**peopleware** Personnel who design, program, operate, and maintain computer equipment.

**perforator** Keyboard device for punching paper tape.

**perform** To execute instructions in a computer.

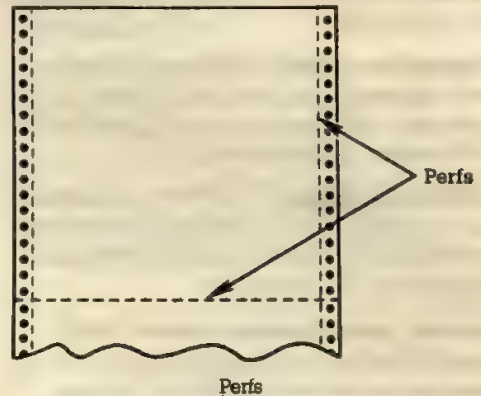
**performance** Major factor in determining the total *productivity* of a system. Largely de-

termined by a combination of availability, throughput, and response time.

**performance monitor** Program that keeps track of service levels being delivered by a computer system.

**perfor** Detachable perforated strips on the two sides of fanfold computer paper.

**perfs** Perforations in paper to facilitate removing pin-feed edges and tearing continuous paper into separate pages.



**periodic report** Report that provides information to users on a regular basis.

**peripheral equipment** Input/output units and auxiliary storage units of a computer system, attached by cables to the central processing unit. Used to get data in and data out, and to act as a reservoir for large amounts of data that cannot be held in the central processing unit at one time. The card reader, typewriter, and disk storage unit are examples of peripherals.

**peripheral equipment operator** In a busy computer room, the computer operator is assigned to the console and rarely leaves it. Additional people assist by mounting and demounting disk packs and tapes, placing cards in the card reader, labeling outputs, and operating the various input/output devices as directed. These people are usually called peripheral equipment operators.

## peripheral slots

**peripheral slots** Empty slots built into the housing of some computers so printed circuit cards can be added to increase capabilities without hardware modification. Motherboard sockets into which circuit boards can be plugged.

**permanent storage** Same as *storage*.

**persistence** In essence, the "staying power" of a lighted *phosphor*. Since a phosphor begins to dim after it's excited by the electron guns, a long-persistence screen allows the phosphor to dim more slowly.

**personal computer** Moderately priced *microcomputer* system intended for personal use rather than commercial purposes. See *desktop computer* and *portable computer*.

**personal computing** Use of a personal computer (usually a *microcomputer*) by individuals for applications such as entertainment, home management, and education.

## personal identification number (PIN)

Security number that computer systems sometimes require before a user can access the system or before a point-of-sale terminal user can enter or receive information. Commonly used with automatic teller machines.

**personalized form letter** Computer-generated form letter produced by a word processing system or a *merge-print program*.

**PERT** Acronym for Program Evaluation and Review Technique, a management technique for control of large-scale, long-term projects, involving analysis of the time frame required for each step in a process and the relationships of the completion of each step to activity in succeeding steps. See *critical path method*. Compare *GERT*.

**PERT chart** Diagram representing the interdependencies of work elements against time, typically shown graphically as circles and connecting lines.

**petri nets** Popular and useful model for the

representation of systems with concurrency or parallelism

**phased conversion** Method of system implementation in which the old information system is gradually replaced by the new one. Compare *parallel conversion*. Contrast with *direct conversion*.

**phonemes** Distinct sounds that make up human speech (speech utterances such as lk, ch, and sh). Smallest components of speech.

**phonetic system** System that uses data based on voice information (*phonemes*) to produce sounds that emulate speech. See *voice output* and *voice synthesis*.

**phosphor** Rare earth material used to coat the inside face of cathode ray tubes. Holds the light generated by a monitor's electron guns. Each dot on the screen is actually a phosphor that glows for a given length of time. The dots are used to create an image

**photocomposition** Application of electronic processing to the preparation of print. Involves the specification and setting of type, and its production by a photographic process.

**photoelectric devices** Devices that give an electrical signal in response to visible, infrared, or ultraviolet radiation.

**photo-optic memory** Memory that uses an optical medium for storage. For example, a laser might be used to record on photographic film. See *optical disk*.

**photo-pattern generation** Production of an integrated circuit mask by exposing a pattern of overlapping or adjacent rectangular areas.

**photo plotter** Output device that generates high-precision artwork masters photographically for printed circuit board design and integrated circuit masks.

**photoresist** Process, utilized in etching semiconductor devices, of selectively removing



the oxidized surface of a silicon wafer by masking the part that is to be retained.

**phototypesetter** Computer-controlled device that converts text into professional-quality type. Virtually all books are typeset on a phototypesetter.

**physical design** Refers to how data is kept on storage devices and how it is accessed.

**physical record** Unit of data for input or output, such as a punched card, a tape *block*, or a record on a disk. One or more *logical* records may be contained in one physical record.

**physical security** Guards, badges, locks, alarm systems, and other measures to control access to the equipment in a computer center.

**pi ( $\pi$ )** Greek letter representing the ratio of a circle to its diameter. The numerical value of pi, calculated to eight decimal places, is 3.14159265.

**pica** (1) Type size that fits ten characters into each inch of type. (2) In phototypesetting, a sixth of an inch.

**picking device** Input device, such as a *light pen*, *mouse*, or *joystick*, used to enter data on a display screen.

**pico** Prefix meaning one-trillionth. Contrast with *tera*, one trillion.

**picocomputer** Computer capable of processing data in trillionths of a second.

**picosecond** One trillionth of a second; one thousandth of a nanosecond; abbreviated *psec*.

**picture element** See *pixel* and *wetzel*.

**picture graph** Bar graph that uses symbols instead of bars.

**picture processing** See *image processing*.

**picture tube** Cathode ray tube used as a television picture tube.

**pie chart** Graphical representation of information; charting technique used to represent portions of a whole. (See page 222.)

**piezoelectric** Property of some crystals that undergo mechanical stress when subjected to voltages, or that produce a voltage when subjected to mechanical stress.

**piggyback board** Small printed circuit board mounted on a larger circuit board to add additional features to the larger circuit board.

**piggyback file** File capable of having records added at the end, without having to re-copy the entire file.

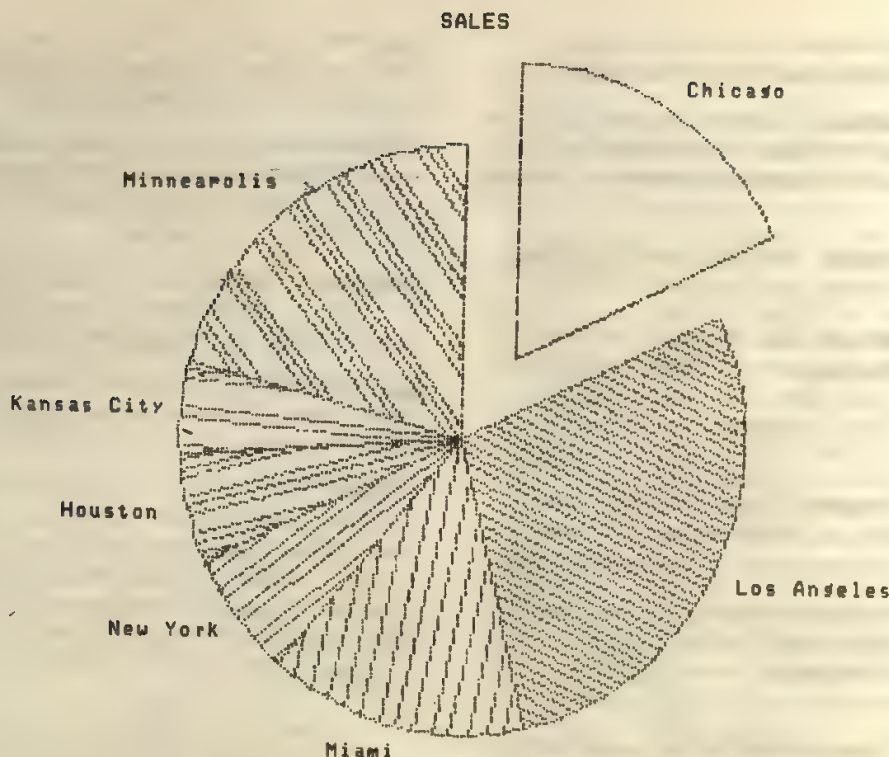
**PILOT** Textually based computer language originally designed as an author language for *computer-assisted instruction*. Also used for teaching computer programming to beginners. Composed of powerful and nearly syntax-free conversation-processing statements.

```
R: Tests the ability to find a verb.
1C: t: = t + 1
T: What is the verb in "Peter
    Piper picked pickled peppers."?
A:
M: picked
YT: Right!
YE:
X: t > 3
NT: Wrong! Try again.
NJ: 1
T: The verb was "picked".
```

PILOT

**pilot method** Act of trying a new computer system in one area rather than on a wider range of activities. For example, the implementation of a new information system into an organization whereby only a small part of the business uses the new system until it has proved to be successful.

**pin** Connection point on a component, printed circuit board, or logic element, where electrical connections can be made.



**PIN** Acronym for *Personal Identification Number*.

**pin compatible** Pertaining to chips and devices that perform identical functions and can be substituted for one another. The devices use the same pins for the same input/output signals.

**pin-feed** Paper-feed system that relies on a pin-studded roller to draw paper, punched with matching sprocket holes, into a printer. See *tractor-feed mechanism*. Contrast with *friction-feed*.

**pingpong** To alternate two or more storage devices so processing can take place on a virtually endless set of files.

**pins** Small metal connectors on a DIP that fit into sockets on a printed circuit board.

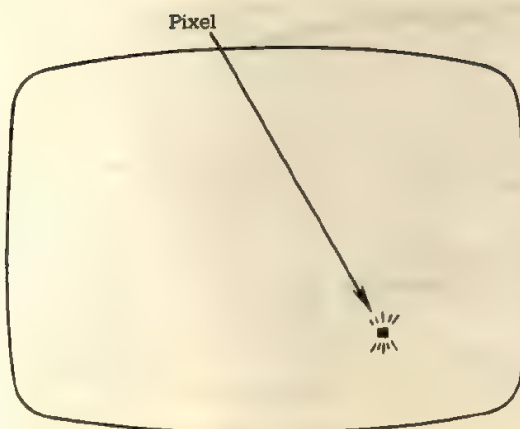
**pipeline** Overlapping operating cycle function used to increase the speed of computers. Involves decomposing a computer instruction in parts so it can be executed simultaneously.

**piracy** See *software piracy*.

**pitch** Density of characters on a printed line, usually expressed in terms of characters per inch; for example, 10 pitch means that 10 characters are printed in every inch.

**pixel** Short for "picture element," a picture cell. The visual display screen is divided into rows and columns of tiny dots, squares, or cells, each of which is a pixel. Smallest unit on the display screen grid that can be stored, displayed, or addressed. A computed picture is typically composed of a rectangular array of pixels, such as 1 000 by 1 000. The number of





Pixel

pixels in one dimension is frequently used as the *resolution* of the picture, as in a 1 000-line resolution image. Compare *wetzel*.

**PLA** Acronym for *Programmable Logic Array*, an alternative to ROM that uses a standard logic network programmed to perform a specific function. Implemented in either MOS or bipolar circuits. See *FPLA*.

**plaintext** Term used by encryption experts to denote an ordinary message in its original meaningful form. See *cryptanalysis*.

**planimeter** Peripheral device that measures the surface area of a plane figure when the perimeter of that figure is traced with a stylus.

**PLANIT** Acronym for *Programming LAN-guage for Interactive Teaching*, a language designed for use with *computer-assisted instruction* systems.

**plansheet** Same as *spreadsheet*, *worksheet*.

**plasma display panel** Type of VDT utilizing trapped neon/argon gas. The image is created by turning on points in a matrix (energized grid of wires) comprising the display surface. The high-resolution image is steady, long-lasting, bright, and flicker-free; selective erasing is possible.

**platen** A backing, commonly cylindrical,

against which printing mechanisms strike to produce an impression.

**PLATO** Acronym for *Programmed Logic for Automatic Teaching Operations*, a computer-based instructional system that uses large computers and plasma display terminals. Contains thousands of lessons representing sixty-five fields of study for all levels from kindergarten through graduate school. See *computer-assisted instruction*

**platter** That part of a hard disk drive that actually stores the information. A round, flat, metallic plate covered on both surfaces with a brown magnetic substance. See *hard disk*.

**PL/C** Version of the PL/I programming language, designed to be used in an educational environment. (See page 224.)

**PL/I** High-level general-purpose language designed to process both scientific and business applications. Contains many of the best features of FORTRAN, COBOL, ALGOL, and other languages, as well as a number of facilities not available in previous languages. (See page 224.)

**PL/M** Programming language used to program microcomputers, developed by Intel Corporation. High-level language that can fully command the microcomputer to produce efficient run-time object code. Designed as a tool to help microcomputer programmers concentrate more on their problem or application and less on the actual task of programming. Derived from PL/I, a general-purpose programming language, and usually implemented as a *cross-compiler*.

**PL/M Plus** Extended version of PL/M developed by National Semiconductor to simplify programming of their microprocessors.

**plot** To diagram, draw, or map with a *plotter*. (See page 225.)

**plotter** Output unit that graphs data by automatically controlled pens. Data are normally plotted as a series of incremental steps, which

```

DCL NUMBERS (3,5) FIXED (5);
DCL TOTAL (5) FIXED (10) INIT ((5)0);
DO I= 1 TO 5;
    DO J = 1 TO 3;
        GET LIST (NUMBERS (J,I));
        TOTAL (I) = TOTAL (I) + NUMBERS (J,I);
    END;
END;

```

PL/C

can be so tiny as to constitute smooth lines, such as isobars. Primary plotter types include *drum*, *pen*, *flatbed*, and *electrostatic*. Also called *digital plotter*, *incremental plotter*, and

*X-Y plotter*.

**plotter resolution** See *resolution*, *plotter*.

**plotting a curve** Locating points from coor-

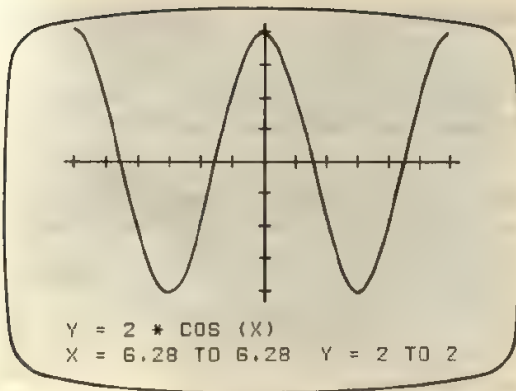
```

WEATHER PROCEDURE;
    DECLARE MAXDAY (7), MINDAY (7), AVERAGE (7);
    READ LIST ((MAXDAY (1), MINDAY (1)) I = 1 TO 7);
    AVERAGE = (MAXDAY + MINDAY) /2;
    WRITE ((MAXDAY (1), MINDAY (1), AVERAGE (1))
    (I = 1 TO 7) (ZF (5), F(8,1), SPACE));
END WEATHER;

```

PL/I





Plot

ordinates and connecting these points with a curve that approximates or resembles the actual curve that pictures the relationship existing between variables.

**plug** Connector on a cable that goes to a jack on a part of the system. See *male connector*.

**plugboard** Perforated board used to control the operations of unit record devices. Also called *control panel*.

**plug compatible** Peripheral device that requires no interface modification to be linked directly to another manufacturer's computer system.

**PMOS** Acronym for P-channel MOS, the oldest type of MOS circuit, in which the electrical current consists of a flow of positive charges. Contrast with *N-channel MOS*.

**PN** Acronym for *Polish notation*

**poaching** Accessing files or program listings in search of information to which the user is not entitled.

**pocket computer** Portable, battery-operated, *hand-held computer* that can be programmed in BASIC to perform a wide number of applications. Able to process small amounts of data under the control of complex stored programs.

**point** Smallest unit of graphic information, representing a single location on a coordinate system.

**pointer** (1) Address or other indication of one storage location as held in another storage location. Used in a network database to point to related records in the same or different files. See *network database management system* and *stack pointer*. (2) With some computer systems, the shape on the display screen that marks the relative location of the *mouse*.

**point identification** Complete description of a graphics point, including its coordinate location and any special processing functions implied by it.

**point-of-sale terminal (POS)** Device used in retail establishments to record sales information in a form that can be input directly into a computer. This *intelligent terminal* is used to capture data in retail stores, often with the



Point-of-sale terminal

## point set curve

capability of verifying the creditworthiness of the customer. See *POS systems* and *source-data automation*.

**point set curve** Curve defined by a series of short lines drawn between points.

**point-to-point line** Communications system configuration consisting of a direct line between the host computer and a remote terminal. Either *leased lines* or *switched lines* may be used. Contrast with *multidrop line*.

**Poisson theory** Mathematical method for estimating the number of lines needed to handle a given amount of data communications traffic.

**POKE** Computer-language instruction used to place a value (poke) into any location in the computer's programmable memory. See *PEEK*.

**POL** Acronym for *Procedure-Oriented Language* or *Problem-Oriented Language*.

**polar** Pertaining to a situation in which binary 1 is represented by current flow in one direction and binary 0 by current flow in the opposite direction. Contrast with *positive true logic*.

**polar coordinates** Graphic system for specifying the location of a point by reference to an angle and a distance from a fixed point. Contrast with *Cartesian coordinate system*.

**polarizing filter** Accessory for terminal screens to reduce glare.

**Polish notation (PN)** Logical notation for a series of arithmetic operations in which no grouping symbol is used. Form of *prefix notation* developed by Polish logician Jan Lukasiewicz in 1929. Contrast with *reverse Polish notation*.

**polling** Communications control method used by some computer/terminal systems whereby a host station asks many devices attached to a common transmission medium, in turn, whether they have information to send. Contrast with *addressing*.

**polyphase sort** External tape sort used for six or fewer tapes

**pooler** Device for consolidating and/or converting key entry data into a form acceptable to the main computer

**pop** To pull or retrieve data from the top of a program *pushdown stack*. The stack pointer is decremented to address the last word pushed on the stack. The contents of this location are moved to one of the accumulators or to another register. Also called pull. Contrast with *push*.

**pop instruction** Computer instruction that executes the *pop* operation.

**POP-2** *List processing language* developed at the University of Edinburgh.

**populated board** Circuit board that contains all of its electronic components. Contrast with *unpopulated board*.

**port** That portion of a computer through which a peripheral device may communicate. See *input/output channel* and *interface*.

**portability** Ease with which a program can be moved from one computer environment to another. Many programs written in high-level languages may be used on different machines. These programs are, therefore, portable.

**portable** (1) Pertaining to a computer that can be hand carried from one physical location to another. See *microcomputer* and *hand-held computer*. (2) Pertaining to a program that can be easily executed on several different computers.

**portable computer** *Microcomputer* system that can be moved easily from one location to another. Physical size is about the same as a small typewriter. See *briefcase computer*, *desktop computer*, *lap computer*, *notebook computer*, and *personal computer*.

**portable program** Software that can be used on compatible computer systems.

**POS** Acronym for *Point-of-Sale terminal*.





Portable computer

**positional notation** Method for expressing a quantity by using two or more figures where in the successive right-to-left figures are to be interpreted as coefficients of ascending integer powers of the *radix*. In the decimal numeral 634, which has a radix of 10, the value is  $4 \times 10^0 + 3 \times 10^1 + 6 \times 10^2$ .

**positive true logic** Logic system in which a lower voltage represents a bit value of 0 and a higher voltage represents a bit value of 1. Contrast with *polar*.

**POS systems** Department stores and supermarkets are currently using POS systems, in which the cash register is actually a special-purpose computer terminal that can monitor and record transactions directly in the store's data files for inventory control, checks on credit card validity, and other data handling functions. See *point-of-sale terminal*.

**post** To enter a unit of information on a record.

**post edit** To edit output data from a previous computation.

**postfix notation** Arithmetic notation system whereby the *operator* follows the *operands*. Addition of 5 and 3 would be expressed as  $53 +$ . *Reverse Polish notation* is a form of postfix

notation. Contrast with *prefix notation* and *infix notation*.

**post-implementation review** Evaluation of a system after it has been in use for several months. Compare *system follow-up*.

**post mortem** Analysis of an operation after its completion.

**post mortem dump** Storage dump taken at the end of the execution of a program. Contrast with *snapshot dump*.

**potentiometer** Device used to develop electrical output signals proportional to mechanical movement.

**power** Symbolic representation of the number of times a number is multiplied by itself. The process is called *exponentiation*. 4 to the power of 3 means  $4 \times 4 \times 4$ ; and is written  $4^3$ .

**power amplifying circuit** Electronic circuit that converts an input AC voltage into an output DC voltage. Compare *power supply*.

**power down** (1) To turn off a computer or peripheral device. (2) Steps a computer may take to preserve the state of the processor and to prevent damage to it or to connected peripherals when the power fails or is shut off. Contrast with *power up*.

**power fail/restart** Facility that enables a computer to return to normal operation after a power failure.

**powerful** Hardware is considered powerful if it is faster, larger, and can accomplish more work than comparable machines. Software is considered powerful if it is efficient and provides a wide range of options.

**power on** To turn the power switch to the ON position or otherwise supply electric current to a device. Also called *power up*.

**power supply** Electrical circuit that converts AC voltage to low-voltage DC. The output of a power supply is tightly regulated to keep noise pulses and voltage variations from upsetting

## power surge

the computer's circuits. Compare *power amplifying circuit* and *rectifier*.

**power surge** A sudden, brief increase in the flow of current that can cause problems in the proper operation of computer equipment.

**power up** (1) To turn on a computer or peripheral device. (2) Steps taken by a computer processor when the power is turned on, or restored after a power failure. The processor and peripherals are initialized so that program execution may be started. Contrast with *power down*.

**pph** Abbreviation for pages per hour.

**PPM** Acronym for Pulse Position Modulation, pulse time modulation in which the value of each instantaneous sample of the wave modulates the position in time of a pulse. Contrast with *PM* and *PDM*.

**pragmatics** Investigation of the relationship between symbols and the users of those symbols. See *programming linguistics*.

**precedence** Rules that state which operators should be executed first in an expression. Same as *hierarchy*. See *order of operations*.

**precision** Degree of exactness with which a quantity is stated. A calculation may have more *precision* than *accuracy*: the true value of  $\pi$  to six significant digits is 3.14159; the number 3.14162 is precise to six digits, but as a value for  $\pi$  is accurate only to about five. See *single precision*, *double precision*, and *triple precision*.

**precompiler** Computer program that processes the source code of another computer program immediately before that program is to be compiled. It may provide the programmer with one or more of the following: (1) Ability to use convenient abbreviations that are not acceptable to the compiler itself: the precompiler expands (transcribes) the shorthand version into source code that is acceptable to the compiler. (2) Ability to use nonstandard program-

ming statements that are not acceptable to the compiler. This may be done to aid *structured programming* in a language that is not well suited to it. The added statements are translated into standard-language statements by this structured programming precompiler. (3) Ability to enforce standards. Source statements written by a programmer can be edited for usages that violate the standards the programmer is supposed to be following. See *compiler* and *p-code*.

**predefined function** Standard mathematical procedure available to the user for inclusion in a program.

**predefined process** (1) Process identified only by name and defined elsewhere. (2) *Closed subroutine*.

**predefined process symbol** Rectangular flowcharting symbol used to represent a subroutine.

**predictive reports** Business reports used for tactical and strategic decision making.

**pre-edit** See *edit*.

**prefix notation** Method of forming mathematical expressions in which each operator precedes its operands. The expression "x plus y multiplied by z" would be represented by  $+xy \times z$ . Addition of 5 and 3 would be expressed as  $+53$ . *Polish notation* is a form of prefix notation. Contrast with *infix notation* and *postfix notation*.

**p-register** Program-counter register in which the location of the current instruction is kept.

**preliminary study** See *feasibility study*.

**preprinted forms** Forms that can contain computer-produced output but that enter a computer system with headings and identifying information already imprinted. Commonly used in producing *external reports*.

**preprocessor** Program that performs conversion, formatting, condensing, or other functions on input data prior to further processing.



**presentation graphics** High-quality business graphics intended to visually reinforce points made in the presentation of proposals, plans, and budgets to top management.

**preset** To establish an initial condition, such as control values of a loop or initial values in index registers. See *initialize*.

**press** Act of pushing down and holding the button on a *mouse*. See *click*.

**pressure-sensitive keyboard** Keyboard constructed of two thin plastic sheets coated with a circuit made of electrically conductive ink. Economical, flat keyboard used in several low-priced microcomputers.

**pressure-sensitive pen** Stylus used with a *digitizer*. Contains a pressure transducer that detects and transmits writing pressure as Z-axis data.

**PRESTEL** Commercial *videotex* service in Great Britain.

**preventive maintenance** Processes used in a computer system that attempt to keep equipment in continuous operating condition by detecting, isolating, and correcting failures before their occurrence. Involves cleaning and adjusting the equipment as well as testing the equipment under both normal and marginal conditions. See *marginal checking*. Contrast with *corrective maintenance*.

**primary cluster** Buildup of table entries around a single table location.

**primary colors** Set of colors from which all others can be derived, but which cannot be produced from each other. The additive primaries (light) are blue, green, and red. The subtractive primaries (colorant) are cyan, magenta, and yellow. The psychological primaries are the pairs red/green, yellow/blue, and black/white.

**primary key** Unique field for a record, used to sort records for processing or to locate a particular record within a file.

**primary storage** See *internal storage*.

**prime shift** Working shift that coincides with the normal business hours of an organization, as opposed to swing shift or graveyard shift.

**primitive** (1) Basic or fundamental unit, often referring to the lowest level of a machine instruction or the lowest unit of *language translation*. (2) In computer graphics the most basic graphic entities available, such as points, line segments, or characters.

**primitive element** Graphics element, such as a line segment or point, that can be readily called up and extrapolated or combined with other primitive elements to form more complex objects or images.

**print chart** Form used to describe the format of an output report from a printer. Also called printer spacing chart, printer design form, and *print layout sheet*.

**print control character** Control character for operations on a line printer, such as carriage return, page ejection, or line spacing.

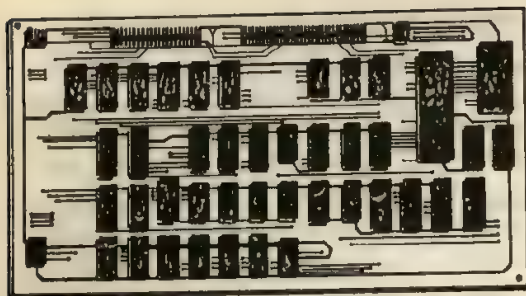
**print density** Number of printed characters per unit of measurement, such as the number of characters on a page.

**printed circuit (PC)** Electronic circuit that is printed, vacuum deposited, or electroplated on a flat insulating sheet.

**printed circuit board (PCB)** Circuit board whose electrical connections are made through conductive material contained on the board itself, rather than with individual wires. Electrical components—such as integrated circuit chips, resistors, transistors, diodes, and switches—are then mounted on the board. (See page 230.)

**print element** That part of a printer that actually puts the image on paper. Popular print elements are the *typeball*, *daisy wheel*, and *thimble*. Also called *print head*.

**printer** Output device that produces hard-



Printed circuit board

copy output. See *character printer*, *electrostatic printer*, and *line printer*.

**printer format** Pertaining to printing paper divided into print zones. Only one value can be printed in each zone.

**printer stand** Wood or metal stand designed to support a printer. Has an opening in the top for fanfold printer paper.

**print head** See *print element*.

**print layout sheet** Chart used for establishing margin and spacing requirements for a printed report. See *print chart*.

**printout** Form of computer system output, printed on a page by a printer. See *hard copy*.

**print quality** Quality of a printout produced on a printer. See *draft quality* and *letter quality*.

**print wheel** Single element providing the character set at one printing position of a wheel printer. See *daisy wheel*.

**print zone** In BASIC programming, a fixed-length area on an output device within which data are aligned in columns.

**priority interrupt** Any *interrupt* given preference over other interrupts within the system.

**priority processing** Processing of a sequence of jobs on the basis of assigned priorities. See *job queue*.

**Privacy Act of 1974** See *Federal Privacy Act* and *Freedom of Information Act*.

**private automatic branch exchange (PABX)** Private automatic telephone switching system that provides telephone communications within a business or factory and controls the transmission of calls to and from the public telephone network.

**private line** Channel or circuit furnished to a user for exclusive use.

**privately leased line** Communications line intended for the use of a single customer. See *leased lines*.

**privileged instruction** Computer instruction not available for use in ordinary programs written by users; its use is restricted to the routines of the *operating system*. See *storage key* and *storage protection*.

**probabilistic model** Model that makes use of the mathematics of probability. Used to analyze data whose individual values are unknown but whose long-range behavior can be predicted.

**probability** Measure of the odds of a given event taking place. For example, on a coin flip, the probability is  $\frac{1}{2}$  that it will show heads and  $\frac{1}{2}$  that it will show tails. If ten chips marked 0-9 were mixed, upside down on a table, the probability of drawing one with a numeral greater than 6 would be  $\frac{3}{10}$ .

**probability theory** Measure of the likelihood of occurrence of a chance event. Used to predict the behavior of a group. See *operations research*.

**problem analysis** Use of a plan to solve a problem. First step in the *program development cycle*.

**problem definition** (1) Formulation of the logic used to define a problem. (2) Description of a task to be performed.

**problem description** In information processing, the statement of a problem. May in-



clude a description of the method of solution, the solution itself, the transformation of data, and the relationship of procedures, data, constraints, and environment.

### problem-oriented language (POL)

Programming language designed for the convenient expression of a given class of problems. Contrast with *assembly language*, *machine language*, and *procedure-oriented language*. See *APT*, *COGO*, *GPSS*, and *RPG*.

**problem program** Program executed when the central processing unit is in the "problem state"; any program that does not contain *privileged instructions*.

**problem solving** A problem that can be solved by a computer need not be described by an exact mathematical equation, but it does need a certain set of rules that the computer can follow. If the solution to a problem depends upon intuition or guessing, or if the problem is badly defined, the computer cannot be used to solve it. A computer cannot perform tasks properly unless problems are specified correctly in every detail. The instructions must also list in complete detail each step of the solution. Here is an overview of problem-solving steps: (1) A computer user studies the problem and prepares a plan of action, perhaps with the aid

of an analyst. (2) A programmer, or the analyst, decides which steps the computer must take to obtain the desired results and specifies the form of input and output. (3) This plan of action is then coded into a set of steps in a programming language. (4) These instructions are prepared for input by keying them directly into the computer's memory via a keyboard or by keying them onto a magnetic disk or magnetic tape. (5) Once in the computer's memory, the program is translated into machine language (the only language the computer understands) by a translating program called an *interpreter*, *compiler*, or *assembler*. (6) The program is now ready to be executed by the computer. The steps of the program are carried out on the data used with the program, and the output is generated.

**procedure** (1) Course of action taken for the solution of a problem. (2) Portion of a high-level-language program that performs a specific task necessary for the program. (3) Another name for a computer program.

**procedure division** Fourth of four main parts of a *COBOL* program.

**procedure-oriented language (POL)** Any high-level, machine-independent programming language designed for the convenient expres-

```

100 REM *** DIVE SHOP CALCULATION ***
110 REM *** C - AMOUNT ***
120 REM *** L - YEARS ***
130 REM *** X - LOOPING COUNTER - YEAR COUNTER ***
140 REM *** PRINT TABLE HEADING ***
150 PRINT "YEAR", "DEPRECIATION", "BOOK VALUE"
160 LET C = 9000
170 LET L = 20
180 FOR X = 1 TO L
190     REM *** COMPUTE DEPRECIATION ***
200     LET D = 2 * C/L
210     REM *** COMPUTE BOOK VALUE ***
220     LET C = C - D
230     REM *** PRINT X, D, AND C ***
240     PRINT X, D, C
250 NEXT X
260 END

```

Procedure-oriented language

sion of procedures used in the solution of a wide class of problems. Contrast with *assembly language*, *machine language*, and *problem-oriented language*. See *Ada*, *ALGOL*, *APL*, *BASIC*, *C*, *COBOL*, *FORTH*, *FORTRAN*, *JOVIAL*, *LOGO*, *NELLAC*, *Pascal*, *PILOT*, *PLANIT*, *PL/I*, *SIMSCRIPT*, *SNOBOL*, and *WATFOR*.

**process** (1) Systematic sequence of operations to produce a specified result. (2) To transform raw data into useful information.

**process bound** Situation in which the computer system is limited by the speed of the processor.

**process control** Use of the computer to control industrial processes, such as oil refining and steel production.

**process-control computer** Digital computer used in a process-control system. Generally limited in instruction capacity, word length, and accuracy. Designed for continuous operation in nonair-conditioned facilities.

**process conversion** Changing the method of running the computer system.

**processing** Computer manipulation of data in solving a problem. See *data processing*.

**processing symbol** Rectangular *flow-charting symbol* used to indicate any processing operation, such as calculating, initializing a counter, or moving data.

**processor** Device or system capable of performing operations upon data, such as a *central processing unit* (hardware) or *compiler* (software). A compiler is sometimes referred to as a *language processor*.

**processor bound** Pertaining to system performance that is slowed by the time it takes the central processing unit to perform the actual processing or computations. Same as *compute-bound*. See *limiting operation*. Contrast with *I/O bound*.

**production run** Execution of a debugged program that routinely accomplishes its pur-

pose. For example, running a payroll program to produce weekly paychecks is a production run.

**productivity** Measure of the work performed by a software/hardware system. Largely depends on a combination of the system's *facility* and *performance*.

**program** Series of instructions that will cause a computer to process data. It may be in a high-level source form, which requires intermediate processing before the computer can execute it, or it may be in an object form directly executable by the computer.

**program card** Card punched with specific coding and used to control the automatic operations of keypunch and verifier machines.

**program chaining** Process of linking programs or program sections together. Allows programs that are larger than internal memory to be executed through sequential loading and execution of successive sections or modules of that program.

**program coding** Process of writing instructions in a programming language.

**program control** Descriptive of a system in which a computer is used to direct the operation.

**program counter** Counter that indicates the location of the next program instruction to be executed by the computer. Same as *instruction counter*.

**program deck** Set of punched cards con-



Program deck

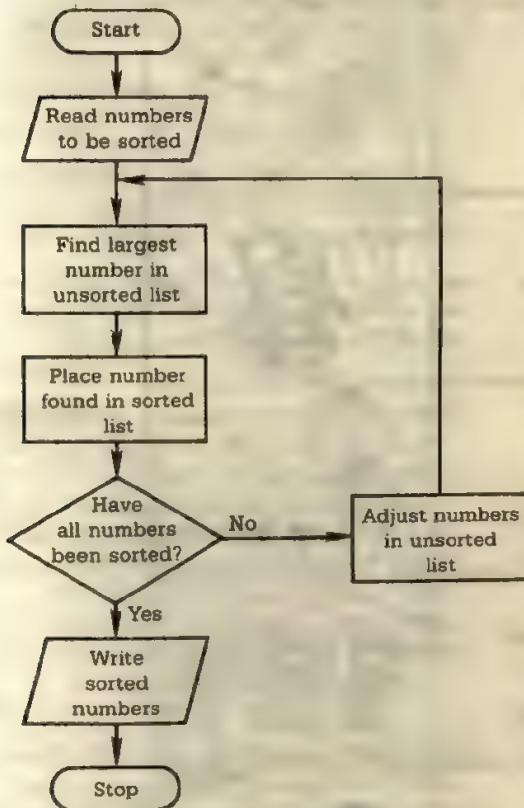


taining instructions that make up a computer program.

**program development cycle** Steps involved in the solution of a problem with a computer: *problem analysis*, algorithm development, coding, *program testing*, *documentation*, and *delivery*. See *design cycle*. (See page 234.)

**program file** File containing computer programs.

**program flowchart** Diagram composed of symbols, directional lines, and information about how the computer will be used to solve a problem. See *flowchart*. Contrast with *system flowchart*.



Program flowchart

**program generator** See *generator*.

**program graph** Graphical representation of a program.

**program ID** Program identification.

**program language** See *programming language*.

**program library** Collection of available computer programs and routines, or portions of programs. Contents of the library are stored for reuse. If they are complete programs, they may be simply reused as is. Parts of programs may be copied into other programs to reduce labor and standardize the use of those copied parts in new programs.

**program listing** See *listing*.

**programmable calculator** Calculatorlike device with certain computerlike features, such as a calculator that can execute a stored program written in BASIC.

**programmable communications interface** Interface board used for communications control.

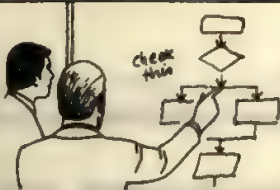
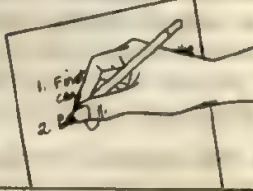
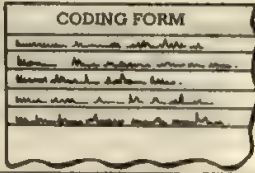
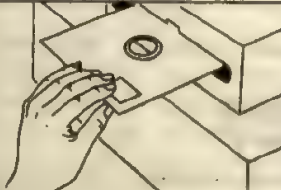


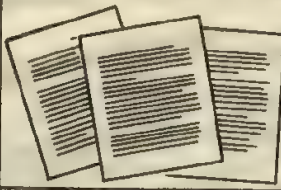

**programmable function key** Keyboard key whose function changes with the programs within the computer.

**programmable logic array (PLA)** Device that provides the sum of a partial product with outputs for a given set of inputs. See *FPLA* and *PLA*.

**programmable memory** Content-changeable memory, where most computer programs and data are stored. Usually *RAM* or *PROM*. Contrast with *ROM*. See *storage*.

**programmable read-only memory (PROM)** Memory that can be programmed by electrical pulses. Once programmed, it is read-only. A special machine (called a *PROM programmer*) is used to write in the new program on blank *PROM* chips. Compare *EPROM* and *EAROM*.

**program maintenance** Process of keeping programs up to date by correcting errors, making changes as requirements change, and al-

1	<b>DEFINING THE PROBLEM</b> The problem is studied and defined; a method of solution is developed.	
2	<b>PROGRAM DESIGN</b> The problem's solution is represented as an algorithm.	
3	<b>CODING THE PROGRAM</b> Each step of the problem's solution is converted into computer instructions in the form of a language such as BASIC.	
4	<b>EXECUTING THE PROGRAM</b> The set of instructions (program) is placed into the computer and the computer is directed to execute the program.	
5	<b>DEBUGGING THE PROGRAM</b> The program is checked to eliminate errors ("bugs").	
6	<b>TESTING THE PROGRAM</b> The program is tested to determine if it does what it is supposed to do.	
7	<b>DOCUMENTING THE PROGRAM</b> Write-ups, program listings, operating instructions, etc., are assembled for future program modification or for individuals who may want to use the program.	
8	<b>PROGRAM MAINTENANCE</b> The program is kept functioning at an acceptable level.	

Program development cycle



tering the programs to take advantage of equipment changes.

**programmed check** Check consisting of tests inserted into the programmed statement of a problem and performed by the use of computer instructions.

**programmed instruction** Sequence of specific instructions for teaching a specific subject. Many fields of study, including several computer programming training courses, use programmed-instruction techniques. Especially useful in self-study courses because of the built-in feedback.

**programmed label** To make the identification of disk and tape files more reliable, most programs include a built-in routine that creates a label record at the beginning of the file. See *tape label*. Contrast with *external label*.

**programmer** See *computer programmer*.

**programmer/analyst** Person whose major tasks involve combining system analysis and design functions with programming activities.

**programmer board** Board that allows a user to program PROM or EPROM memories for use in his or her computer system. See *PROM programmer*.

**programming** Process of translating a problem from its physical environment to a language that a computer can understand and obey. Planning the procedure for solving a problem. This may involve, among other things, the analysis of the problem, coding of the problem, establishing input/output formats, establishing testing and checkout procedures, allocation of storage, preparation of documentation, and supervision of the running of the program on a computer.

**programming aids** Computer programs that aid computer users, such as compilers, debugging packages, linkage editors, and mathematical subroutines.

**programming language** Scheme of formal

notation by which a programmer specifies computer programs to the computer hardware. Hundreds exist, ranging from machine-oriented languages very difficult for a human to follow or use to high-level languages that require intermediate translation before they can be used by the machine.

**programming librarian** One of three nucleus members of the *chief programmer team*. Maintains and operates the development support library. Duties include code creation, submission of computer runs, and filing and logging of all outputs.

**programming linguistics** Three interconnected concepts of syntax, semantics, and pragmatics that can be used to describe languages for communication between any two systems, whether mechanical, electrical, or human

**programming team** Group of individuals assigned to a programming project. See *chief programmer*.

**program specifications** Document that identifies the data requirements of a system, the files required, the input/output specifications, and the processing details.

**program stack** Area of computer memory set aside for temporary storage of data and instructions, particularly during an interrupt. See *pop*, *push*, *pushdown list*, *pushdown stack*, and *stack*.

**program stop** Stop instruction built into the program that will automatically stop the computer under certain conditions, upon reaching the end of the processing, or upon completing the solution of a problem.

**program storage** Portion of *internal storage* reserved for the storage of programs, routines, and subroutines. In many systems, protection devices are used to prevent inadvertent alteration of the contents.

**program switch** Point in a programming routine at which two courses of action are pos-

## program testing

sible, the correct one being determined by a condition prevailing elsewhere in the program or by a physical disposition of the system.

**program testing** Executing a program with test data to ascertain that it functions as expected. See *testing*.

**progress reporting** Input of actual time, resource utilization, and task/activity completions.

**project control** Phase of a project management cycle that compares actual performance with the planned schedule and implements corrective measures to avoid project completion delays.

**projecting** Producing a two-dimensional graphics display of a three-dimensional scene.

**projection** Extension of past trends into the future. Computer-supplied information can be invaluable in this business management technique.

**project library** Database of projects, tasks, and activities that can be modified and applied when planning new projects.

**project manager** Person responsible for the enforcement of a project's goals. Sometimes called a 'project team leader.

**project plan** Phase of a project management cycle that involves the development and organization of the work plan.

**project schedule** Phase of a project management cycle that details the start and completion times for each task and activity.

**PROLOG** Acronym for PROgramming in LOGic, a logic-based programming language popular in *artificial intelligence*. AI programming language most popular in Japan.

**PROM** Acronym for *Programmable Read-Only Memory*.

**PROM programmer** Device used to program PROMs and reprogram EPROMs by elec-

trical pulses. Sometimes called PROM burner. See *programmer board*.

**prompt** Character or message provided by the computer to indicate that it is ready to accept keyboard input. Usually an on-screen question or instruction that tells the user which data to enter or what action to take, such as "Enter name:"

**proofing program** Same as *dictionary program* or *spelling checker*.

**propagated error** Error or mistake occurring in one operation and affecting data required for subsequent operations so the error or mistake is spread through much of the processed data.

**propagation delay** Time delay in a satellite communications system.

**proportional spacing** If the horizontal space allotted to a printed character is proportional to the width of that character, the spacing is said to be proportional. Since this book is typeset in proportional spacing, the "w" in the word "write" consumes more space than the "i." Standard typewriter style, in contrast, allots equal space to all characters.

**proposition** Statement in logic that can be true or false.

**proprietary software** Program owned by an individual or business because it is either copyrighted or not yet released to the public. One cannot legally use or copy this software without permission. Contrast with *public domain software*. See *software piracy*.

**protect** To prevent unauthorized access to programs or a computer system. To shield against harm. Often means write-protecting a disk.

**protected storage** Storage locations reserved for special purposes, in which data cannot be stored without undergoing a screening procedure to establish suitability for storage therein.

**protocol** Set of rules governing the exchange



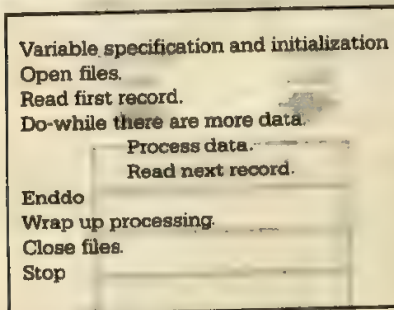
of information between computer systems. For example, an IBM Personal Computer and an Apple Macintosh computer must establish a protocol before they can telecommunicate. See *handshaking*.

**prototype** First version or model of a software package or computer hardware device or system ready for preproduction testing.

**proving** Testing a machine to demonstrate that it is free from faults, usually after corrective maintenance.

**psec** Abbreviation for *picosecond*; one trillionth of a second.

**pseudocode** (1) Arbitrary system of symbols used to represent operators, operands, operations, index registers, and so forth. (2) Method of program design often used in place of *flowcharts*. Uses English-like statements in outline wherein the level of indentation facilitates understanding of the program logic.



**pseudocomputer** Software interpreter program written in the native machine language of a conventional microprocessor.

**pseudolanguage** Language, not directly understandable by a computer, used to write computer programs. Before a pseudoprogram can be used, it must be translated into a language that the computer understands (machine language). Same as *symbolic language*.

**pseudo-operation** Operation that is not part of the computer's operation repertoire as real-

ized by hardware; hence, an extension of the set of machine operations.

**pseudorandom number** Number generated by a computer in a deterministic manner. These numbers have been subjected to many statistical tests of randomness and, for most practical purposes, one can be used as a *random number*.

**p-system** Microcomputer operating system with a principal advantage that programs written for it will work on a wide variety of machines. Translates *p-code* into the machine language appropriate to a specific computer. See *UCSD P-system*.

**publication language** Well-defined form of a programming language suitable for use in publications. A language such as this is necessary because some languages use special characters that are not available in common type fonts.

**public domain software** (1) Software, not protected by copyright laws and therefore free for all to reproduce and trade without fear of legal prosecution. Any computer program donated to the public by its creator. (2) Free programs available from telecomputing services or *bulletin boards*. Contrast with *proprietary software*.

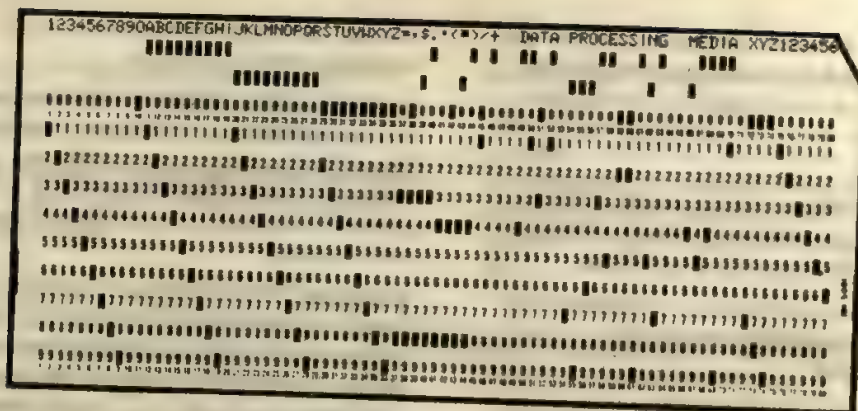
**public network** Communications service open to anyone, usually on a fee basis.

**puck** Hand-held, manually controlled, graphics input device used to pinpoint coordinates on a *graphics tablet*. Has a transparent window containing cross hairs and allows coordinate data to be digitized into the system from a drawing placed on the data tablet or digitizer surface.

**pull** See *pop*.

**pull-down menu** Menu that can be displayed by moving the *mouse* pointer to a title, then pressing the mouse button.

**pull instruction** Instruction that pulls or retrieves data from the top of the program push-down stack. Same as *pop instruction*.



Punched card

**pulse** Abrupt change in voltage, either positive or negative, that conveys information to a circuit.

**pulse modulation** Use of a series of pulses that are modulated or characterized to convey information. Types of pulse modulation include amplitude (PAM), position (PPM), and duration (PDM) systems.

**punched card** Cardboard card used in data processing operations, in which tiny rectangular holes at (possibly) hundreds of individual locations denote numerical values and alphanumeric codes. See *Hollerith card*, *ninety-column card*, and *ninety-six-column card*.

**punched-card code** See *card code* and *Hollerith code*.

**punching position** One of the divisions of a card column into which a hole may be punched.

**punching station** Area on the keypunch and card punch machine where a card is aligned for the punching process.

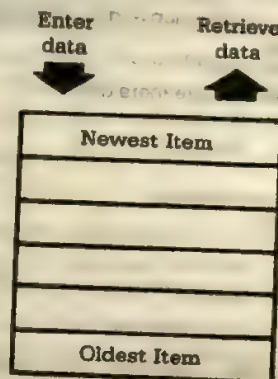
**pure procedure** Procedure that never modifies any part of itself during execution.

**purge** To erase a file.

**push** Putting data into the top location of a *program stack*. The stack pointer is automati-

cally incremented to point to the next location which becomes the top of the stack. Also called *put*. Contrast with *pop*.

**pushdown list** List written from the bottom up, with each new entry placed at the top of the list. The item to be processed first is the one on the top of the list. See *LIFO*.



Pushdown list

**pushdown stack** Set of memory locations or registers in a computer that implements a pushdown list.

**push instruction** Computer instruction that implements a *push* operation.

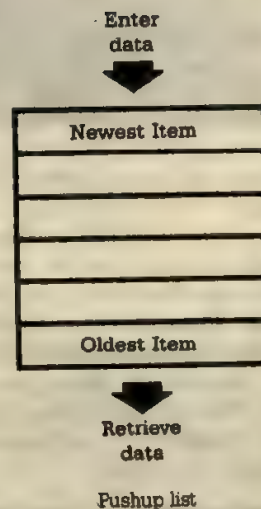
**push-pop stack** Register that receives information from the program counter and stores



the address locations of instructions on a last-in-first-out basis. Two operations are involved in stack processing: pushing describes the filling of the stack from registers; popping involves emptying the stack for transfer to registers.

**pushup list** List of items in which each item is entered at the end of the list and the other items maintain their same relative position in the list. See *FIFO*.

**put** See *push*.



# Q

**quad-density** Term used to specify the data storage density of a computer disk system. Quad-density systems can store up to four times the data that can be stored on single-density disks. Double-sided double-density disks are quad-density disks.

**quadratic quotient search** Hashing algorithm that uses a quadratic offset when probing subsequent table locations.

**quality control** Technique for evaluating the quality of product being processed by checking it against a predetermined standard and taking the proper corrective action if the quality falls below the standard.

**quality engineering** Establishment and execution of tests to measure product quality and adherence to acceptance criteria.

**quantify** To assign numeric values to nonnumeric objects.

**quantity** Any positive or negative real number in the mathematical sense.

**quantum** Smallest unit of measure employed in a system.

**quasi language** See *pseudolanguage*.

**QUBE** Information utility that is part of an advanced cable-TV system providing viewers everything from first-run movies to special programs for doctors and lawyers. Interactive *viewdata-type service*.

**query** To ask for information. To make a request for information from a database system.

**query by example** To ask for information from a database system by defining the qualifications for selected records on a sample record rather than describing a procedure for finding the information.

**query language** (1) Set of commands used to extract from a database any data that need specific criteria. Same as *data manipulating language*. Compare *nonprocedural query language*. (2) Very high-level *natural language* that allows the user to make inquiries of a computer system without knowing any codes or keywords. Special software analyzes the user's request, interprets its likely meaning, and responds on the display screen. See *Intellect*.

**query response** Message sent to a computer terminal in answer to a specific request from the operator.

**question-answer** Process of interacting with the computer. The computer asks the user a question, and the user provides the answer.

**queue** Group of items waiting to be acted upon by the computer, such as messages to be transmitted in a data communications system. The arrangement of items determines the processing priority. See *job queue*.

**queued access method** Any access method that automatically synchronizes the transfer of data between the program using the access method and the input/output devices, thereby eliminating delays for I/O operations.



**queuing** Method of controlling the information processing sequence.

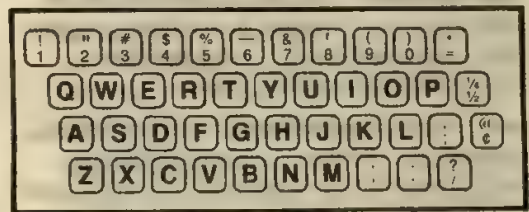
**queuing theory** Form of *probability theory* useful in studying delays or lineups at servicing points. Research technique concerned with the correct sequential orders of moving units. May include sequence assignments for bits of information or whole messages. See *operations research*.

**quibinary code** Binary coded decimal code used to represent decimal numbers in which each decimal digit is represented by seven binary digits.

**quick disconnect** Type of electrical connector that allows rapid locking and unlocking of the mating connector halves

**QWERTY keyboard** Keyboard arrangement that is standard on most keyboards found on typewriters, word processors, and computers.

Developed more than a century ago to slow down swift typists and prevent jamming of the old mechanical typewriters. The design is called QWERTY after the first six letters on the top alphabetic line of the keyboard. Now that electronics can accommodate high-speed typing, QWERTY is no longer efficient. Many businesses are replacing QWERTY keyboards with the more efficient *Dvorak keyboard*. Some computer companies now offer keyboards with a switch that will change from one keyboard to the other. Contrast with *Maltron keyboard*.



QWERTY keyboard

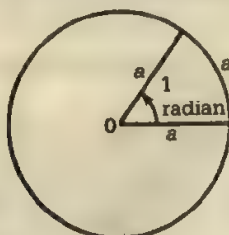
# R

**R** Acronym for *register*, *request*, and *reset*.

**race condition** Indeterminate state that results when two computer instructions are operating concurrently and it is not possible to know which one will finish first.

**rack** Metal frame or chassis on which panels of electrical, electronic, or other equipment such as amplifiers and power supply units, may be mounted.

**radian** Central angle subtended in a circle by an arc whose length is equal to the radius of the circle. Thus the radian measure of an angle is the ratio of the arc it subtends to the radius of the circle in which it is the central angle (a constant ratio for all such circles). A straight line (180-degree angle) has an angle of  $\pi$ , or 3.1415927, radians; a 90-degree angle is 1.5707963, or  $\pi/2$  radians. Trigonometric functions in many high-level programming languages work on radians rather than degrees.



Radian

**Radio Shack** Manufacturer and distributor of electronic equipment, including microcomputer systems. Division of the Tandy Corporation.

**radix** Base number in a number system,

such as 2 in the binary system or 10 in the decimal system. Synonymous with *base*.

**radix complement** See *complement*.

**radix point** In a number system, the character (a dot) or implied character that separates the integral part of a numeral from the fractional part. See *binary point*, *decimal point*, *hexadecimal point*, and *octal point*.

110.011

Binary point

467.32

Decimal point

3F.6A7

Hexadecimal point

72.24

Octal point

Radix point

**radix sorting** Same as *digital sorting*.

**ragged left** Refers to text printed with a straight right margin and an uneven left margin. Also called *flush right*. Contrast with *left justify*.

**ragged right** Text printed with a straight left margin and an uneven right margin. Also called *flush left*. Contrast with *right justify*.

**raised flooring** Elevated flooring used in computer rooms so connecting cables can be laid directly between equipment units.



**RALU** Acronym for Register, Arithmetic, and Logic Unit, a major part of a microprocessor where arithmetic and logic operations are performed.

**RAM** Acronym for *Random Access Memory*, a memory into which the user can enter information and instructions (write) and from which the user can call up data (read). Working memory of the computer, into which applications programs can be loaded from outside and then executed.

**RAM card** Printed circuit board containing RAM chips. By plugging such a board into some computers, their *internal storage* can be expanded.

**random access** Process of obtaining data from, or placing data into, a storage location in which access is independent of the order of storage. Another name for *direct access*. Contrast with *sequential access*.

**random access memory (RAM)** Memory whose contents can be read or written on directly without regard to any other memory location. See *RAM*.

**random files** Files not organized in any sequence. Data are retrieved based on the address of the record on the direct access device.

**random logic design** Designing a system by using discrete logic circuits.

**random number** Patternless sequence of digits. Unpredictable number, produced by chance, that satisfies one or more of the tests for randomness. See *pseudorandom number*.

**random-number generator** Computer program or hardware designed to produce a *pseudorandom number* or series of pseudorandom numbers according to specified limitations.

**random processing** Processing of data randomly. Same as direct access processing. Contrast with *sequential processing*.

**range** Span of values that an element may assume.

**range check** Check applied to a numeric element to verify that it falls within a particular range, such as the months being in the range of 01 to 12. See *data editing*.

**rank** (1) To arrange in an ascending or descending series according to importance. (2) Measure of the relative position in a group, series, array, or classification.

**raster display** Video display that sweeps a beam through a fixed pattern, building up an image with a matrix of points. See *raster graphics*. Contrast with *vector display*.

**raster fill** Process used by a graphics camera to fill in the spaces between the raster lines of a video screen to give a screen picture a more finished appearance.

**raster graphics** Manner of storing and displaying data as horizontal rows of uniform grid or picture cells (*pixels*). *Raster scan* devices recreate or refresh a display screen thirty to sixty times a second to provide clear images for viewing. *Raster display* devices are generally faster and less expensive than vector tubes.

**raster scan** Generation of an image on a display screen made by *refreshing* the display area line by line.

**rat's nest** Feature on printed circuit design systems that allows users to view all the computer-determined interconnections between components. This makes it easier to determine whether further component placement improvement is necessary to optimize signal routing.

**raw data** Data that have not been processed. Such data may or may not be on machine-readable media. Also called *original data*.

**RDBMS** Acronym for *relational database management system*.

**read** To get information from any input or file storage media, such as reading punched cards by detecting the pattern of holes, or reading a magnetic disk by sensing the patterns of magnetism. Contrast with *write*.

**reader**

**reader** Any device capable of transcribing data from an input medium.

**read head** Magnetic head designed to read data from the media. Contrast with *write head*. Compare *read/write head*.

**reading station** That part of a card punch and keypunch where a data card is aligned for reading by a sensing mechanism.

**reading wand** Device that senses marks and codes optically, such as a device that reads price tags in a point-of-sale terminal.

**read ink** See *nonreflective ink*.

**read-only memory (ROM)** Special type of computer memory, permanently programmed with one group of frequently used instructions. Does not lose its program when the computer's power is turned off, but the program cannot be changed by the user. In many microcomputers, the BASIC language interpreter and operating systems are contained in ROM. Several of the newer microcomputers use plug-in ROM modules that contain special programs, such as game, educational, and business programs. See *EPROM*, *firmware*, *PROM*, and *solid state cartridge*.

**read-only storage** See *read-only memory*.

**readout** Manner in which a computer represents the processed information, such as by visual display, line printer, and digital plotter.

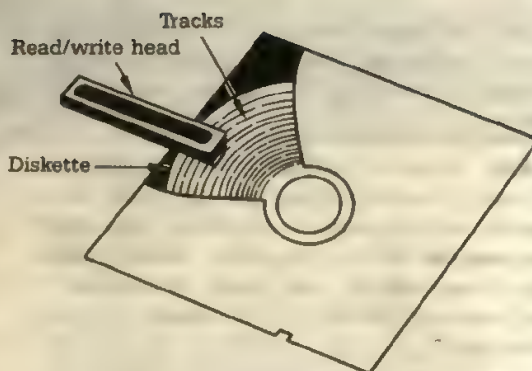
**read/write head** Small electromagnet used to read, write, or erase data on a magnetic storage device, such as a disk, tape, drum, or magnetic card. See *read head* and *write head*.

**real constant** Number that contains a decimal point, such as 26.4 or -349.0. Also called *floating-point constant*.

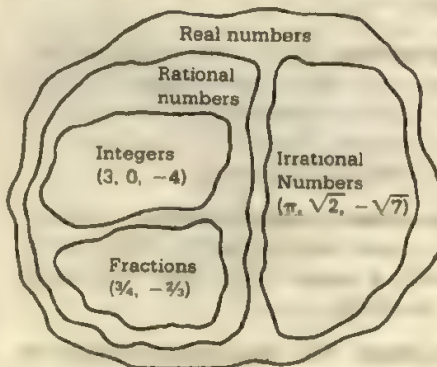
**real number** Any rational or irrational number.

**real storage** Internal storage in a virtual storage system.

**real-time** Descriptive of on-line computer



Read/write head



Real numbers

processing systems that receive and process data quickly enough to produce output to control, direct, or affect the outcome of an ongoing activity or process. For example, in an airline reservations system, a customer-booking inquiry is entered into the computer to see whether space is available. If a seat is booked, the file of available seats is updated immediately, thus giving an up-to-date record of seats reserved and seats available. See *transaction-oriented processing*.

**real-time clock** Piece of hardware that interrupts the processor at fixed time intervals to synchronize the operations of the computer with events occurring in the outside world, often involving human/computer interaction.



**real-time image generation** Performance of the computations necessary to update an image being completed within the refresh rate, so the sequence appears correctly to the viewer. An example is flight simulation, in which thousands of computations must be performed to present an animated image, all within the rate of 30–60 cycles per second at which the frames change.

**real-time output** Output data removed from a system at a time of need by another system.

**real-time systems** Computer systems in which the computer is required to perform its tasks within the time restraints of some process or simultaneously with the system it is assisting. Usually, the computer must operate faster than the system assisted so as to be ready to intervene appropriately.

**reasonableness check** Technique whereby tests are made on processed data to indicate whether a gross error exists. Programming instructions would check if the data lies within preset upper and lower limits and initiate some action if the data are not reasonable. See *data editing*.

**reboot** To stop and *boot* the operating system again. Usually occurs by human intervention as the result of a problem. Similar to "reset" on a home appliance. To *restart*.

**receive** To capture messages transmitted by a sender.

**receive only (RO)** Designation used to indicate the read-only capabilities of terminals and other equipment lacking keyboards. See *RO terminal*. Contrast with *send only*.

**receiver** Recipient of messages dispatched by a sender.

**recompile** To compile a program again, usually after debugging or because the program needs to be run on a different type of computer.

**reconstruction** Restoring the database sys-

tem to a previous state after data have been tampered with or destroyed.

**record** Collection of related items of data treated as a unit. Description of an item in a *database*. Each item is represented by a record that consists of one or more *fields*. Everyday examples of a record include an entry in a dictionary or a listing in a phone book.

**recording density** Number of useful storage cells per unit of length or area; for example, the number of characters per inch on a magnetic tape or the number of bits per inch on a single track of a disk. Also called *packing density*. Most common magnetic tape densities are 800, 1600, and 6250 characters per inch (cpi).

**record layout** Arrangement and structure of data elements in a record, including the size and sequence of its components.

**record length** Measure of the size of a record, usually specified in units such as words, bytes, or characters

**record manager** Another term for *file manager*.

**record number** Number automatically assigned to each new record as it is created. Serves as a reference number and may be transparent to the user

**records management** Custodial care concerned with the creation, retention, and scheduled destruction of an organization's paper and film documents.

**recover** To continue program execution after a failure. To overcome a problem.

**recoverable error** Error condition that can be sensed and corrected, thereby allowing continued operation of a program.

**rectangular coordinate system** System in which every point in a plane is given an address in the form of a pair of numbers, called the coordinates of the point. Same as *Cartesian coordinate system*.

**rectifier** Electrical device that changes alternating current into direct current. Compare *power supply*.

**recurring costs** Budgeted items that are not one-time expenditures, such as personnel, supplies, equipment rental, and overhead costs associated with a computer system.

**recursion** Set of operations or program statements in which one of the operations or statements is specified in terms of the entire set. Continued repetition of the same operation(s).

**recursive** Pertaining to a process that is inherently repetitive. The result of each repetition is usually dependent upon the result of the previous repetition.

**recursive procedure** Procedure *A* that, while being executed, either calls itself or calls another procedure *B*, which in turn calls procedure *A*.

**recursive subroutine** Subroutine capable of calling itself, or a subroutine that invokes another subroutine, which in turn invokes the original subroutine.

**red-green-blue monitor** High-resolution color display unit. See *RGB monitor*.

**reduction** Process of saving computer storage by eliminating empty fields or unnecessary data to reduce the length of records.

**redundancy** (1) Duplication of a feature to prevent system failure in the event of the feature's malfunction. (2) Repetition of information among various files, sometimes necessary but often undesirable.

**redundancy check** Check based on the transfer of more bits or characters than the minimum number required to express the message itself, the added bits or characters having been inserted systematically for checking purposes. See *parity bit* and *parity checking*.

**redundant code** Binary coded decimal value with an added check bit.

**redundant information** Message expressed in such a way that the essence of the information occurs in several ways.

**reentrant** Pertaining to a routine that can be used by two or more independent programs at the same time.

**reentrant code** Assembly-generated machine-language programs that may be shared simultaneously by any number of users.

**reentrant subroutine** In a multiprogramming system, a subroutine of which only one copy resides in internal storage, shared by several programs.

**reference edge** See *aligning edge*.

**reflectance** In optical scanning, a relative value assigned to a character or color of ink when compared with the background.

**reflectance ink** In optical scanning, ink that has a reflectance level that very nearly approximates the acceptable paper reflectance level for a particular optical character reader.

**reflected code** Same as *gray code*.

**reformat** To change the representation of data from one format to another.

**refresh circuitry** Electronic circuitry necessary to restore (1) the information displayed on a visual display screen, and (2) the data stored in dynamic RAM, which steadily lose their charge.

**refresh display cycle** Time between successive raster scans or passes through the vectors to be displayed on a vector device. The phosphors on the face of a CRT are excited and glow as the result of each pass of the electron beam in each refresh cycle. The refresh rate usually occurs at a level fast enough to eliminate the flicker from the brightening and fading of the phosphors each time they are struck. Typically, the image must be regenerated at a rate of 1/30th or 1/60th of a second.



**refreshing** Process of constantly reactivating or restoring information that decays or fades away when left idle. Phosphor on a CRT screen needs to be constantly reactivated by an electron beam to remain illuminated. Typically, the image must be regenerated at a rate of 30 to 60 hertz to avoid *flicker*. Likewise, cells in dynamic memory elements must be repeatedly accessed to avoid losing their contents. See *dynamic RAM* and *raster scan*.

**refresh memory** Area of computer memory that holds values indicating whether a particular dot of a graphics raster is on or off. May also contain information on brightness and color.

**refresh rate** Rate at which the graphic image on a CRT is redrawn in a refresh display, time needed for one refresh of the displayed image.

**regenerate** To renew some quantity. Used in storage devices to write back information that has been read in a destructive manner.

**region** In multiprogramming with a variable number of tasks, a term often used to mean the internal storage space allocated.

**register (R)** High-speed device used in a central processing unit for temporary storage of small amounts of data or intermittent results during processing. See *general-purpose register*.

**registration** Accurate positioning relative to a reference.

**regression analysis** (1) Technique in model-building used to define a dependent variable in terms of a set of independent variables. (2) Construction of a "line of best fit" to best illustrate the pattern of a set of data points.

**regression testing** Tests performed on a previously verified program whenever it is extended or corrected.

**relation** (1) Equality, inequality, or any prop-

erty that can be said to hold (or not hold) for two objects in a specified order. (2) In a relational database model, a table, the basic form of information storage. (3) In a network/hierarchical database model, a named association among sets of entities.

**relational database management system (RDBMS)** Database in which multiple tables can be associated or related to one another based on common data items or fields within the tables. For example, a name and address file might have columns for name, street, city, state, zip, and telephone number. A record could be created for each person by filling in each field. One of the major features of a relational database is the ability to generate a new file with data from two relational files. Compare *hierarchical database management system* and *network database management system*.

**relational expression** Expression that contains one or more relational operators.

**relational model** Database model in which items are functionally related.

**relational operator** Symbol used to compare two values, specifies a condition that may be either true or false, such as = (equal to), < (less than), and > (greater than).

**relational structure** Form of database organization in which all data items are contained in one file and are linked together by a trail of logical pointers. Relationships among these data items can be altered at will and the information can be obtained by interactive query or batch processing.

**relative address** Address to which a base address must be added to form the absolute address of a particular storage location.

**relative coding** Coding that uses machine instructions with relative addresses.

**relative movement** Movement of an object on the screen to a new position in terms of the last position rather than from 0,0. Move 4,8 would move a marked point four units to the

## relay

right and eight units up from the last recorded point. Contrast with *absolute movement*.

**relay** Magnetically operated switch used in pre-electronic computers.

**release version** Version of a program currently available for purchase.

**reliability** Measure of the ability of a program, system, or individual hardware device to function without failure.

**relocatable addresses** Addresses used in a program that can be positioned at almost any place in internal storage.

**relocatable program** Program existing in a form that permits it to be loaded and executed in any available region of a computer's internal storage.

**relocate** To move a program or part of a program coded so it may be executed anywhere in computer storage.

**remarks** Verbal messages inserted into a source-language program that do not cause any computer processing steps but are helpful notes for future users who may attempt to understand or alter the program. Used as *internal documentation*. See *comments*.

**remote** Physically distant from a local computer, such as a terminal or printer.

**remote access** Communication with a computer facility by a station (or stations) distant from the computer.

**remote batch processing** Processing of data in batches at a remote location by using a small computer system. See *batch processing*.

**remote computing services** Services offered to customers by computer service centers. Examples are batch processing, interactive problem solving, and consulting.

**remote job entry (RJE)** Refers to computer programs used to submit processing jobs from remote terminals.

**remote processing** Processing of computer programs through an input/output device remotely connected to a computer system. See *remote batch processing*.

**remote site** Outpost in a distributed computer network.

**remote station** See *remote terminal*.

**remote terminal** Device for communicating with a computer from sites that are physically separated from the computer, often distant enough so that communications facilities, such as telephone lines, are used rather than direct cables. See *terminal*.

**removable media** Diskettes, hard disk cartridges, or cassettes that can be removed from the device that reads data from them or writes data to them.

**reorder point** Lowest amount of stock that can be on hand before ordering more of an item. Essential parameter in *inventory control*.

**repagination** Process in which a word processor adjusts a multipage document as it is revised to ensure uniform page length and appearance.

**repaint** Redrawing of an image on a visual display device to reflect updated graphic or textual data. Feature on many graphics systems that automatically redraws a design displayed on the visual display screen.

**repeat counter** Program counter that records the number of times an event takes place in a program for later comparison.

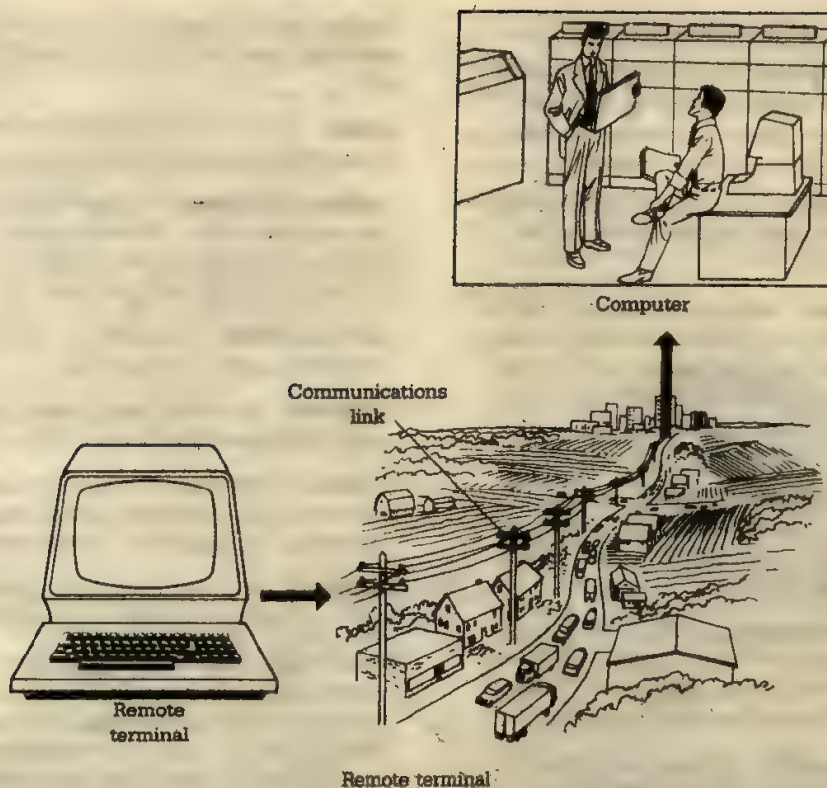
**repeating decimal number** Nonterminating decimal number, such as .333333 . . . or .31282828 . . .

**repeat key** Keyboard key that can be held down so it repeatedly makes contact without need for additional pressing.

**reperforator** Paper-tape punch.

**repertoire** Complete set of instructions that





belongs to a specific computer or family of computers. Also called *instruction set*.

**repetition instruction** Instruction that causes one or more instructions to be executed an indicated number of times.

**replacement theory** Mathematics of deterioration and failure, used to estimate replacement costs and determine optimum replacement policies.

**report** Usually associated with output data; involves the grouping of related facts so as to be easily understood by the reader. Common means of presenting information to users. Most reports are on-screen display or printed listings showing selected information extracted from a database.

**report file** File generated during data pro-

cessing, usually used to print out or display desired output.

**report generation** Manipulation and organization of data to create an on-screen or hard-copy document from all or part of a database file.

**report generator** Program that converts machine-readable data into a printed report organized for a specific purpose. See *RPG*.

**reporting by exception** See *exception reporting*.

**report writer** Utility program that generates standard and custom reports from information stored in data files.

**reproduce** To copy information on a similar medium, such as to obtain a duplicate disk pack from a specific disk pack.

**reproducer**

**reproducer** See *reproducing punch*.

**reproducing punch** Device for duplicating decks of cards. Capable of giving an exact copy of a master deck, or a copy of the deck may be punched in a different format.

**reprogramming** Changing a program written for one computer so that it will run on another.

**reprographics** Technology that includes reproduction and duplication processes for documents, written materials, pictures, drawings, and films, as well as methods of their mass reproduction, such as photocopy, offset printing, microfilming, and offset duplicating.

**request for proposal (RFP)** Document sent to hardware/software vendors requesting them to propose equipment and software to meet system specifications.

**request for quotation (RFQ)** Document sent to hardware/software vendors requesting them to quote prices for equipment and/or software that meets system requirements.

**requirements list** Formal written statements that specify what the software must do or how it must be structured.

**rerun** To repeat all or part of a program on a computer, usually because of a correction, a false start, or an interrupt.

**reserve accumulator** Auxiliary storage register allied to the main accumulator in a central processing unit. See *accumulator*.

**reserved words** Certain words that, because they are reserved by operating systems, language translators, and so on for their own use, cannot be used in an applications program—such as READ, FOR, and LET in the BASIC programming language. See *keyword*.

**reset (R)** (1) To return computer components to a specified static state. (2) To place a binary cell into the zero state.

**reset key** Key on a keyboard that normally is

used to reset the parts of a computer to the way they were before the program was executed.

**reside** To be recorded in. For example, a program may reside on a disk or in memory.

**resident program** Program that occupies a dedicated area of a computer's main memory (ROM or RAM) during the operating session. Contrast with *transient program*.

**residual value** Value of a piece of equipment at the end of a lease term.

**resilient** Pertaining to a system capable of continuing execution despite failure.

**resistor** Component of an electrical circuit that produces heat while offering opposition, or resistance, to the flow of electric current.

**resizing** Process of scaling a graphics file or entity according to predetermined parameters.

**resolution** Amount of information that a video display can reproduce, expressed by the number of *pixels* in the display. A picture with  $560 \times 720$  pixels is much sharper than a picture with  $275 \times 400$  pixels. High resolution produces a finely defined image, yielding a picture that looks smooth and realistic. Low resolution produces surfaces with ragged edges, yielding a picture that is blocky and jagged.

**resolution, plotter** Measure of the quality of a plotted image. The number of addressable points on a digital plotter determines the resolution: the more points, the higher the resolution.

**resource** Any component of a computer configuration. Memory, printers, visual displays, disk storage units, software, materials, and operating personnel are all considered resources.

**resource allocation** Sharing of computer resources among competing tasks or activities.

**resource file** Programs or data, stored on disk or tape, for use by applications programs.



**resource leveling** Scheduling of activities with float time to optimize the use of resources, thereby avoiding large fluctuations in resource requirements.

**resource sharing** Sharing of one central processor by several users as well as several peripheral devices.

**response position** In optical scanning, area designated for marking information on an optical mark recognition form.

**response time** Time it takes the computer system to react to a given input. Interval between an event and the system's response to the event.

**restart** To resume execution of a program. To *reboot*.

**results** Product of computer processing.

**reticle** Photographic plate used to create an integrated circuit mask.

**retrieval** Extraction of data from a database or files.

**retrieving** Process of making stored information available when needed

**retrofit** To update or add to an existing system to improve it.

**return** Set of instructions at the end of a subroutine that permits control to return to the proper point in the main program.

**RETURN key** Key on a computer keyboard used to make the display cursor or a printer carriage move to the beginning of the next line. Used like an *ENTER* key on other keyboards to execute a command.

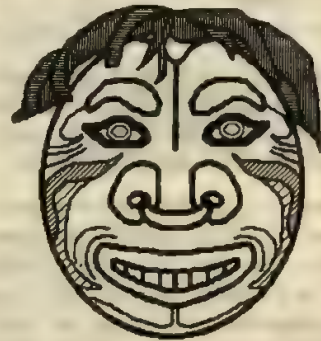
**reusable** Attribute of a routine that permits the same copy of the routine to be used by two or more tasks.

**reverse Polish notation** Form of *postfix notation*, used in Hewlett-Packard calculators, in which the *operands* are entered before the *operators*. The expression  $z = a(b + c)$  is represent-

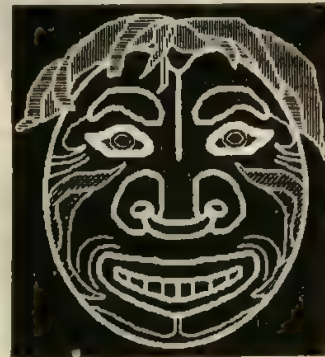
ed in reverse Polish notation as  $bc + a \times z =$ , where this expression is read from left to right. Contrast with *Polish notation*.

**reverse video** In some video terminals, ability to display dark characters on a light background. Reverse of the normal light foreground and dark background colors on a video screen. Also called *inverse video*. See *highlighting* and *image enhancement*.

Normal



Reverse



Reverse video

**review** Evaluation of a new system's performance.

**rewind** To return a magnetic tape to its starting position.

**rewrite** To erase and reset.

**RF** Acronym for Radio Frequency, the general term for a broad spectrum of electromagnetic radiation ranging in frequency from 10,000 to 40 billion cycles per second. RF radiation has been used primarily for the purpose of communication.

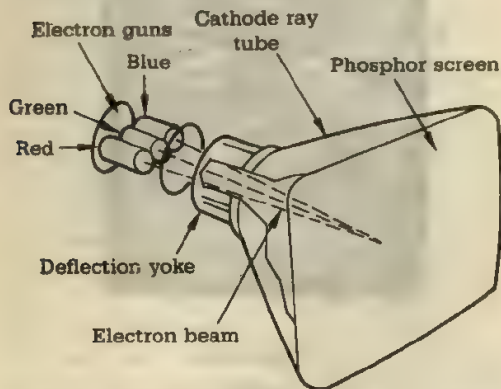
**RF modulator** Device that lets a microcomputer use any ordinary television set for output.

**RFP** Acronym for *Request For Proposal*.

**RFQ** Acronym for *Request for Quotation*.

**RGB monitor** Color monitor that uses color "guns" for red, green, and blue to produce a high-quality picture. See *composite video*, *monochrome monitor*, and *RGB video*.

**RGB video** Form of color video signal (Red, Green, Blue) distinctly different from the composite color video used in standard television sets. Can be displayed only on a color monitor that has a separate electron gun for each of these primary colors. Ordinary color television sets use only one gun. RGB monitors are noted for their crisp, bright colors and high resolution. See *composite video*.



RGB video

**ribbon cable** Group of attached parallel wires; flat cable containing a number of wires side by side. Often used to connect computers with peripherals.

**ribbon cartridge** Plastic holder that contains a printer ribbon.



Ribbon cartridge

**right justify** See *justify*.

**rigid disk** Same as *hard disk*.

**ring** Cyclic arrangement of data elements. See *circular list*.

**ring network** Computer network in which each computer is connected to other computers, forming a continuous loop, or circle. Usually employed when the computers are geographically close. Contrast with *star network*.

**ripple sort** See *bubble sort*.

**RI/SME** Acronym for Robotics International of the Society of Manufacturing Engineers, a professional organization directed toward engineers interested in the design and use of robots.

**RJE** Acronym meaning *Remote Job Entry*.

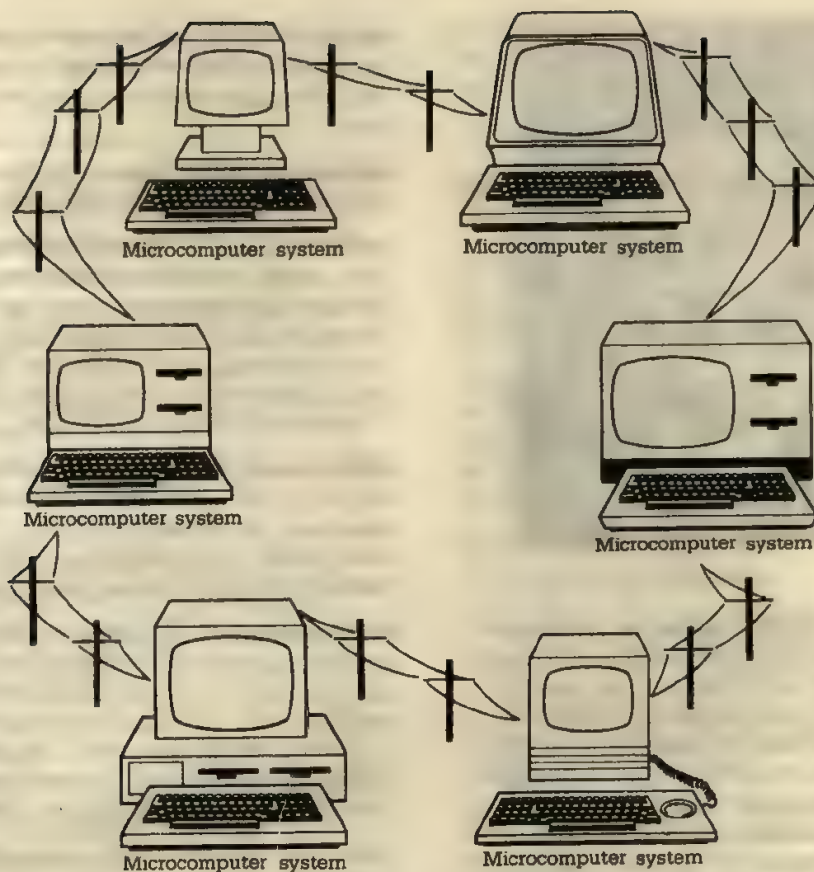
**RO** Acronym for *Receive Only*.

**Roach, John** In 1977, Tandy Corporation's Radio Shack division released the *TRS-80 microcomputer*. Roach, then a vice-president at Radio Shack manufacturing, guided the development of this popular microcomputer. (See page 254.)

**roam** To move a display window around on a visual display screen.

**robot** Computer-controlled device equipped





Ring network

with sensing instruments for detecting input, signals, or environmental conditions, with a calculating mechanism for making decisions, and with a guidance mechanism for providing control. See *ML*, *ROBOTLAN*, and *VAL*.

**robot control languages** Languages for programs that are designed to control robots. *VAL*, *AL*, *ML*, and *ROBOTLAN* are examples of these languages.

#### **Robotic Industries Association (RIA)**

Trade association for the purpose of promoting use and development of robotic technology. Founded in 1974, RIA represents several hun-

dred robot manufacturers, distributors, corporate users, service companies, consultants, and research institutes, and plays an active role in establishing industry standards, reporting statistics, publishing and distributing current robotics information, and representing the robotics industry to government, industry, academia, and the press.

**robotics** Area of artificial intelligence related to robots. Science of robot design and use.

**ROBOTLAN** Programming language used to control robots. See *robot control languages*.



John Roach

**robustness** Quality that causes a software program or set of programs to be able to handle, or at least avoid disaster in the face of, unexpected circumstances, such as when given improper data. An example is the deliberate inclusion of program logic to process anticipated errors in the input, such as testing for the presence of alphabetic data that was accidentally keyboarded into a location reserved for numbers; when such an error is detected, the record containing it is shunted aside from further processing, but program execution is not halted.

**rod memory** Computer storage consisting of wires coated with a nickel/iron alloy and cut in such a way as to form stacks of rods. See *thin film*.

**rollback** System that will restart the running program after a system failure. Snapshots of data and programs are stored at periodic intervals, and the system rolls back to restart at the last recorded snapshot.

**roll out** To record the contents of internal storage in auxiliary storage.

**rollover** Buffer that can store typed characters and commands when they are entered faster than the computer system can process them.

**roll paper** Printer paper in continuous form on a spool. Contrast with *fanfold paper*.

**ROM** Acronym for *Read-Only Memory*. Generally, a solid state storage chip programmed at the time of its manufacture and that cannot be reprogrammed by the computer user. Also called *firmware*, since this implies software that is permanent or firmly in place on a chip. Contrast with *PROM* and *EPROM*.

**ROM cartridge** *Read-only memory* module that contains a preprogrammed function, such as a game, an educational program, or a business system. The nonerasable module is plugged into the computer. See *firmware*.

**ROM simulator** General-purpose device used to replace ROMs or PROMs in a system during program checkout. Because it offers real-time in-circuit simulation, it can be used in the engineering *prototype* or reproduction model to find and correct program errors or in the production model to add new features.

**root** Top element or *node* in a *tree diagram*, from which branches extend eventually to *leaf* nodes.

**rotating memory** Magnetic information storage device in the form of a round platter that is spun like a phonograph record. See *magnetic disk*.

**rotation** In computer graphics, the turning of a computer-modeled object relative to an origin point on a coordinate system. In three-dimensional graphics, an object can be rotated in space, usually around the axis, to provide different views. See *transformation*.

**rotational delay** Time it takes for a record contained on one of the sectors of a disk to rotate under the read/write head.



**RO terminal** Data communications machine capable only of receiving and not of transmitting.

**round** See *round off*.

**rounding** Process of dropping the least significant digit or digits of a numeral, and adjusting the remaining numeral to be as close as possible to the original number.

**round off** To truncate the rightmost digit of a number, and to increase by one the remaining rightmost digit if the truncated digit is greater than or equal to half of the number base. The base 10 number 463.1076 could be rounded to 463.108 or 463.11 or 463.1, depending upon the *precision* desired.

**round-off error** Error resulting from rounding off a quantity by deleting the less significant digits and applying the appropriate rule of correction to the part retained; for example, 0.2751 can be rounded to 0.275 with a round-off error of 0.0001, or rounded to 0.28 with a round-off error of 0.0049. Contrast with *truncation error*.

**round robin** Scheduling method that engages each device and process at its turn in a fixed cycle.

**routine** Short set of program code that performs a specific task. Typically used in reference to assembly-language programs. Sometimes used as a synonym for *program*.

**routing** Assignment of a path for the delivery of a message.

**row** (1) Horizontal members of one line of an *array*. (2) One of the horizontal lines of punching positions on a punched card. (3) Vertical divisions of an electronic spreadsheet. Together with columns, rows serve to form the spreadsheet matrix. Contrast with *column*.

**RPG** Acronym for Report Program Generator, a popular business-oriented programming lan-

guage, highly structured and relatively easy to learn. Allows users to program many business operations as well as to generate reports. Fairly simple RPG programs can perform rather sophisticated business tasks.

**RPROM** Acronym for Reprogrammable PROM. See *EPROM*.

**RS-232C** Industry standard for asynchronous serial data communications between terminal devices, such as printers and computers, and communications equipment, such as modems. Defines a 25-pin connector and certain signal characteristics for interfacing a terminal or computer with a modem. Most popular microcomputers provide for RS-232C interfaces. See *DB-25 connector* and *EIA interface*.

**RS-422** Recently adopted standard for a very high-speed serial port.

**rubber banding** CAD capability that allows a component to be tracked across the visual display screen, by means of an electronic pen or mouse, to a desired location, while simultaneously stretching all related interconnections to maintain signal continuity.

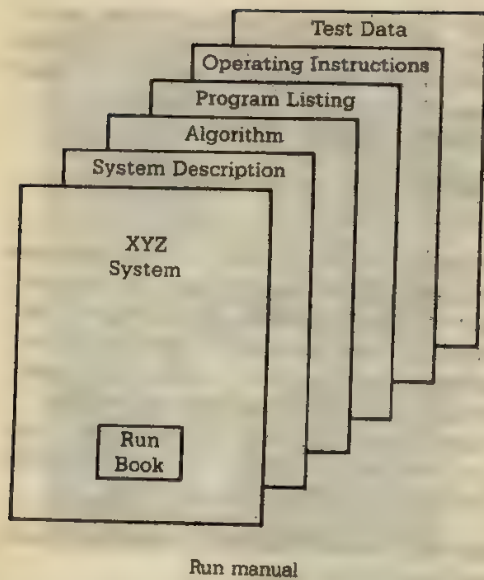
**ruggedized computer** Computer designed to be used in special environments, such as aboard a space vehicle, on a ship, in a missile, in a submarine, in a tank, or in farm equipment.

**rules-based deduction** Technique of obtaining conclusions in which knowledge is represented as a set of simple rules that guide the dialogue between the system and the user.

**run** Single or continuous execution of a program by a computer on a given set of data. See *execute*.

**run manual** Manual or book documenting the processing system, program logic, controls, program changes, and operating instructions associated with a computer run. (See *page 256*.)

run time



**run time** Time during which data are fetched by the control unit and actual processing is performed in the arithmetic-logic unit. Also called *execution time*. Contrast with *compilation time*.

**R/W** Read/Write memory.



# S

**salami technique** Theft of small amounts (slices) of assets from a large number of sources. Embezzlement technique that gets its name from taking a slice at a time, such as a few cents from many bank accounts.

**sales forecasting model** Model used to simulate annual sales for each period of a forecast. Input factors can include market size, selling price, market growth rate, share of the market, measures of competitors' actions, and other factors. Such forecasts often use equations estimated with *regression analysis* and then placed in a *spreadsheet* program.

**SAM** Acronym for Sequential Access Method, a method for storing and retrieving data on a disk file.

**sample data** Set of hypothetical data used to see if a flowchart is logical and if a program works. See *test data*.

**sampling** Obtaining a value of a variable at regular or intermittent intervals.

**sampling rate** Frequency at which sampling occurs.

**sans serif** Letters of typefaces without serifs—the ornate, widened bases and tops seen on some characters of some type fonts.

**sapphire** Material used as a *substrate* for some types of integrated circuit chips.

**satellite** Earth-orbiting device capable of relaying communications signals over long distances. See *communications satellites*.

**satellite communications** Use of orbiting

*transponders* or *microwave* relays to transmit information around the world.

**satellite computer** (1) Additional computer, usually smaller, that supports a larger computer system. An economy of processing can be effected if the satellite computer handles lower-level functions, such as remote terminal coordination, data validity checking, code conversion, and input/output functions. (2) Any offline auxiliary computer.

**saturate** To reach maximum capacity, beyond which nothing else can be absorbed or retained. For example, a diskette is saturated when all of its tracks are full of data.

**save** To store information somewhere other than in the computer's internal memory, such as on a tape or disk, so it can be used again.

**SBC** Acronym for *Small Business Computer* and *Single-Board Computer*.

**scalar value** Integer declared as such in a programming language and possessing a value within a fixed range. Contrast with *vector*.

**scale** (1) To adjust the magnitude of a quantity so as to fit it into the available storage location. (2) To change the size of a graphics file by a specified quantity to make it fit a specified boundary. (3) Quantity by which graphic data are multiplied or divided to fit size limitations.

**scale factor** One or more factors used to multiply or divide quantities occurring in a problem and to convert them into a desired range, such as the range from +1 to -1.

## scaling

**scaling** Process of changing the size of an image. Scaling by a factor of four multiplies all dimensions of an image by 4. See *transformation*.

**scan** (1) To examine point by point in logical sequence. (2) Algorithmic procedure for visiting or listing each node of a data structure. (3) Operation required to produce an image on a visual display screen. See *raster scan*.

**scan area** That area of a form or document that contains information to be scanned by an optical character reader.

**scan line** Horizontal line on a raster display screen.

**scanner** Any optical device that can recognize a specific set of visual symbols.

**scanner channel** Device that polls individual channels to see if they have data ready to be transmitted. See *polling*.

**scanning** Rapid examination of every item in a computer's list of data to see whether a specific condition is met.

**scan path** In optical scanning, a predetermined area within the clear area where data to be read must be located. The position of the scan path and the amount of data that can be read will generally depend upon the machine involved.

**scatter plot** Plot showing a two-variable frequency distribution by plotting a dot or symbol at each data point. Sometimes a line or curve is added to show the correlation (if there is one) between the variables represented on the two axes. Also called scatter diagram.

**scatter read/gather write** "Scatter read" refers to placing information from an input record into nonadjacent storage areas. "Gather write" refers to placing information from nonadjacent storage areas into a single physical record.

**SCDP** Acronym for *Society of Certified Data Processors*.

**scheduled report** Report produced at regular intervals to provide routine information to users.

**scheduled maintenance** Maintenance of a computer system at fixed intervals to maintain its reliability.

**scheduler** Program that schedules jobs for processing.

**scheduling** (1) Task of determining what the succession of programs should be in a multiprogramming computer center. (2) Allocating a nonsharable resource, such as CPU time, or an I/O device to a particular task for a period of time.

**SCHEMA** High-level computer language used by the *database administrator* to define the structure of the database. See *data definition language*.

**schema** Structure for organizing knowledge relative to context or expectations. Particularly applicable to database design. See *subschema*.

**schematic** Diagram of an electronic circuit showing connections and identification of components.

**schematic symbols** Symbols used in schematic diagrams.

**Scheutz, George** (1785–1873) In 1834, started construction of a machine similar to Charles Babbage's *difference engine*. The machine was completed and used for printing mathematical tables. See *Babbage, Charles*.

**Schickhardt, Wilhelm** (1592–1635) German professor of mathematics who invented a calculating machine in 1624.

**scientific applications** Tasks that are traditionally numerically oriented and often require advanced engineering, mathematical, or scientific capabilities. Seldom require the extensive file-handling capabilities of *business applications*.

**scientific notation** Notation in which num-



	Battery
	Wires connected
	Wires not connected
	Ground
	Chassis ground
	Resistor
	Potentiometer
	Capacitor
	Speaker
	Switch
	Fuse
	Relay
	Tunnel diode
	Coil

Schematic symbols

bers are written as a "significant digits" part, or *mantissa*, times an appropriate power of 10, or *exponent*. For example,  $0.32619 \times 10^7$  or  $0.32619E+07$ , stands for 3,261,900. See *E notation*.

**scissoring** Automatic erasing of all portions of a design on the visual display device that lie outside user-specified boundaries. Also called *clipping*.

**SCM** Acronym for Society for Computer Medicine, an organization that brings together physicians and computer scientists, emphasizing the use of automation for medical applications.

**scope** (1) Range of control of a software program. (2) *Oscilloscope*

**SCR** Acronym for Silicon Controlled Rectifier,

a semiconductor device useful in controlling large amounts of DC current or voltage. Basically, it is a diode turned on or off by a signal voltage applied to a control electrode called the *gate*. Its characteristics are similar to the old vacuum tube thyatron, which is why it is sometimes called a *thyristor*.

**scrapbook** Function that stores text and pictures for frequent use in documents.

**scratch** To delete data from memory.

**scratch file** Temporary file created during the processing of substantial files of data by copying all or part of a data set to an auxiliary storage device.

**scratchpad** Small, fast storage used in some computers in place of registers. Also called *cache memory*.

**screen** Surface on which information is displayed, such as a video display screen. See *cathode ray tube, display, and video display terminal*.

**screen dump** Process of transferring the information currently appearing on a display screen to a printer or other hard-copy device.

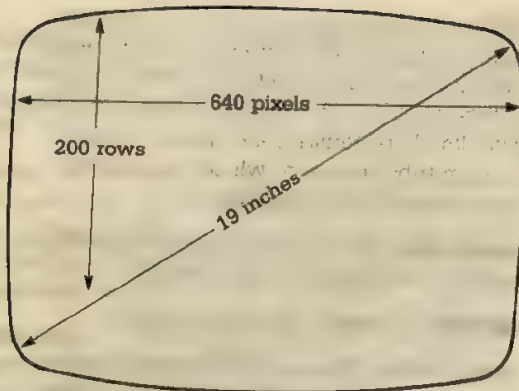
**screen generator** Special utility program used to create customized screen displays.

**screen position** Physical location of graphic data on a visual display screen.

**screen size** Measure of the amount of information that a video display screen can display. Screens can be measured diagonally, as TV sets (usually a diagonal measure in inches), or by the number of vertical and horizontal dot or character positions. See *resolution*. See page 260.)

**screen update** Process of changing screen contents to reflect new information.

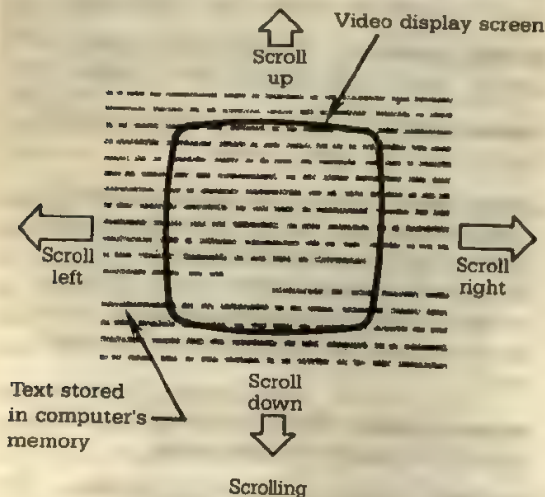
**Scriptsit** Software package used for word processing on Radio Shack TRS-80 microcomputer systems. See *SuperScriptit* and *word processor*.



Screen size

**scripts** Schema-like structures for representing sequences of events.

**scrolling** Movement of data on a video display. This movement of text is repeated until the desired spot in the text has been reached. If the scroll is upward, a new line must appear at the bottom of the screen as an old one disappears at the top. May also refer to the ability to move data from right to left and left to right, as well as downward. Compare *paging*.



**SCS** Acronym for *Society for Computer Simulation*.

**S-curve** Curve plotting personnel versus time; used to smooth out resource allocation. The goal is to develop a gradual build-up and subsequent cutback of personnel by rearranging resources utilized for activities with slack time.

**search** To examine a set of items for those that have some desired property or predetermined criterion, such as a particular name or part number.

**search and replace** Software feature that finds a designated character sequence and replaces it with a new one. Important in word processing applications. See *global search and replace*.

**search key** Data to be compared to specified parts of each item for the purpose of conducting a search.

**search memory** See *associative storage*.

**second** Base unit of time in the SI metric system; also used in the customary English system.

**secondary key** Field used to gain access to records in a file; not required to be unique.

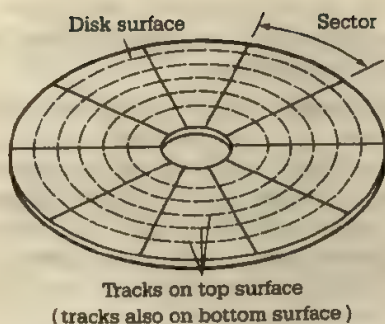
**secondary storage** Memory device that supplements the primary internal memory of a computer. Same as *auxiliary storage*. Contrast with *main storage*.

**second generation computers** Computers belonging to the second era of technological development of computers, when the transistor replaced the vacuum tube. Prominent from 1959 to 1964, when they were displaced by computers using integrated circuitry. Compare *first generation computers*, *third generation computers*, *fourth generation computers*, and *fifth generation computers*.

**second source** Manufacturer who produces a product interchangeable with the product of another manufacturer.

**sector** One of the peripheral elements into





Sector

which each track of a disk surface is divided. See *disk sector*.

**sector method** Method of disk addressing used with flexible disks that divides the surface of a disk into pie-shaped sectors.

**secure kernel** Protected segment of a systems program.

**security** State achieved by hardware, software, or data as a result of successful efforts to prevent damage, theft, or corruption.

**security controls** Methods to ensure that only authorized users have access to a computer system and its resources. See *password*.

**security files** Back-up files for important and critical data and information.

**security program** Program that controls access to data in files and permits only authorized use of terminals and other equipment.

**security specialist** Person responsible for the physical security of the computer center and logical security for data resources.

**seed** Constant used to initiate a *pseudorandom number* generator. Used to generate the first number; all subsequent numbers are based on previous results.

**seek** To position the access mechanism of a direct access device at a specified location.

**seek time** Time required to position the access mechanism of a direct access storage de-

vice at a specified position, such as the time needed to position the read/write head in a drive over the specified track of the disk. See *access time* and *transfer rate*.

**segment** (1) To divide a program into parts such that some segments may reside in internal storage and other segments may reside in auxiliary storage. Each segment will contain the necessary instructions to jump to another segment or to call another segment into internal storage. (2) Smallest functional unit that can be loaded as one logical entity during execution of an overlay program. (3) As applied to the field of telecommunications, a portion of a message that can be contained in a buffer of specified size.

**segmentation** Technique for dividing computer programs into logical, variable-length blocks.

**segmented bar chart** Bar chart made up of two or more segments positioned atop each other to represent elements of a whole. Similar to a pie chart, except that varying sizes of bars can be used to allow comparisons of the whole as well as its constituent parts.

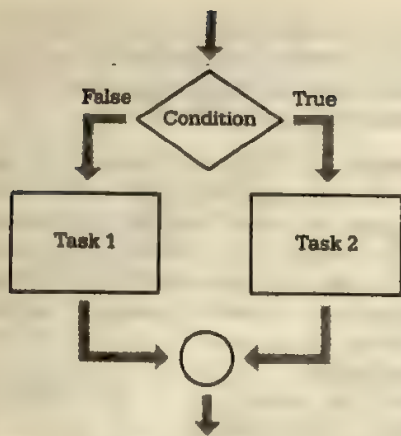
**select** To pick out a group of records from a database according to specifications provided by the user. For example, to select all records with the year greater than 1986.

**selection** Choosing between alternatives.

**selection sort** Sort that selects the extreme value (smallest or largest) in a list, exchanges it with the last value in the list, and repeats with a shorter list.

**selection structure** One of three primary structures of a *structured flowchart*. Provides a choice between two alternative paths, based upon a certain condition. Also called decision structure and IF-THEN-ELSE. See *sequence structure* and *loop structure*. (See page 262.)

**selector channel** In certain computer systems, an input/output channel that can transfer



Selection structure

data to or from only one peripheral device at a time. Contrast with *multiplexer channel*.

**self-adapting** Pertaining to the ability of a system to change its performance characteristics in response to its environment.

**self-checking code** See *error-detecting code*.

**self-compiling compiler** Compiler written in its own source language and capable of compiling itself.

**self-complementing code** Code with the property that the binary *one's complement* of the weighted binary number is also the number's *nine's complement* in decimal notation.

**self-correcting code** Numerical coding system in which transmission errors are automatically detected and corrected. Same as *error-correcting code*.

**self-validating code** Code that makes an explicit attempt to determine its own correctness and proceed accordingly.

**semantics** Study of the science of meaning in language forms. Pertains to the relationships between symbols and what they represent. See *programming linguistics*.

**semaphores** Synchronization primitives used

to coordinate the activities of two or more programs or processes running at the same time and sharing information.

**semiconductor** Solid material, usually germanium or silicon, with an electrical conductivity that lies between the high conductivity of metals and the low conductivity of insulators. Depending on the temperature and pressure, a semiconductor can control a flow of electricity. It is the material from which *integrated circuits* are made.

**semiconductor device** Electronic element fabricated from crystalline materials such as silicon or germanium that, in the pure state, are neither good conductors nor good insulators and are unusable for electronic purposes. When certain impurity atoms, such as phosphorus or arsenic, are diffused into the crystal structure of the pure metal, the electrical neutrality is upset, introducing positive or negative charge carriers. *Diodes* and *transistors* can then be implemented.

**semiconductor storage** Memory device whose storage elements are formed as solid state electronic components on an integrated circuit chip

**semirandom access** Method of locating data in storage that combines in the search for the desired item some form of direct access, usually followed by a limited sequential search.

**sense** (1) To examine, particularly relative to a criterion. (2) To determine the present arrangement of some element of hardware. (3) To read holes punched on a card or tape.

**sense probe** Input mechanism that activates sensitive points on a visual display screen and thereby provides input to a computer.

**sense switch** Computer console switch that may be interrogated by a program. Very useful when debugging a large, complex program.

**sensitivity** Degree of response of a control unit to a change in the incoming signal.

**sensors** Devices to detect and measure

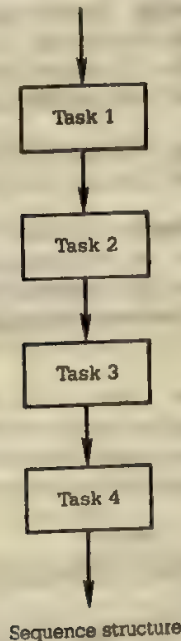


physical phenomena, such as temperature, stress, heartbeat, wind direction, and fire. Translate physical stimuli into electronic signals that may, for example, be input into computers.

**sequence** (1) Arrangement of items according to a specified set of rules. (2) In numeric sequence, normally in ascending order.

**sequence check** Check used to prove that a set of data is arranged in ascending or descending order.

**sequence structure** One of three primary structures of a *structured flowchart*, in which instructions are executed in order. See *selection structure* and *loop structure*.



**sequential** Pertaining to the occurrence of events in time sequence, with little or no simultaneity or overlap of events.

**sequential access** Process of obtaining data from storage files in the order in which it was stored. Required with magnetic tape, which must be searched serially from the beginning

to find any desired record. May be used with magnetic disk storage, which is more commonly accessed randomly. Also called *serial access*. Contrast with *direct access*.

**sequential computer** Computer in which events occur in time sequence with little or no simultaneity or overlap of events.

**sequential data set** Data set whose records are organized on the basis of their successive physical positions, such as on magnetic tape.

**sequential data structure** Data structure in which one *atom* is immediately adjacent to the next atom. Also called *contiguous data structure*.

**sequential device** Peripheral device from which data are read or into which data are written in order; nothing can be omitted.

**sequential file organization** Organization of records in a specific sequence based on a key, such as part number or employee ID. Records in sequential files must be processed one after another.

**sequential list** List stored in contiguous locations. Also called *dense list* and *linear list*.

**sequential logic** Circuit arrangement in which the output state is determined by the previous state of the input. Contrast with *combination logic*.

**sequential machine** Mathematical model of a certain type of sequential switching circuit.

**sequential processing** Processing of files ordered numerically or alphabetically by key. Contrast with *direct access processing* and *random processing*.

**sequential storage** Auxiliary storage where data are arranged in ascending or descending order, usually by item number.

**serial** (1) Pertaining to the sequential occurrence of two or more related activities in a single device. (2) Handling of data in a sequential fashion. Contrast with *parallel*.

**serial access** Descriptive of a storage device or medium in which there is a sequential relationship between access time and data location in storage; that is, the access time is dependent upon the location of the data. Also called *sequential access*. Contrast with *direct access*. See *serial processing*.

**serial adder** Adder that performs its operations by bringing in one digit at a time from each of the quantities involved. Contrast with *parallel adder*.

**serial computer** Computer in which each digit or data word bit is processed serially by the computer. Contrast with *parallel computer*.

**serial data** Data transmitted sequentially, one bit at a time.

**serial input/output** Data transmission in which the bits are sent one by one over a single wire. Contrast with *parallel input/output*.

**serial interface** Interface on which all the data moves over the same wire, one bit after the other. Contrast with *parallel interface*.

**serializability** When several users access data at the same time, the result must be equivalent to that which occurs when they access the data one at a time. This effect is called *serializability*.

**serial operation** Computer operation in which all digits of a word are handled sequentially rather than simultaneously. See *conversa-*

*tional operation*. Contrast with *parallel operation*.

**serial port** Input/output port in a computer through which data are transmitted and received one bit at a time. In most cases, in personal computers, serial data are passed through an RS-232C serial interface port.

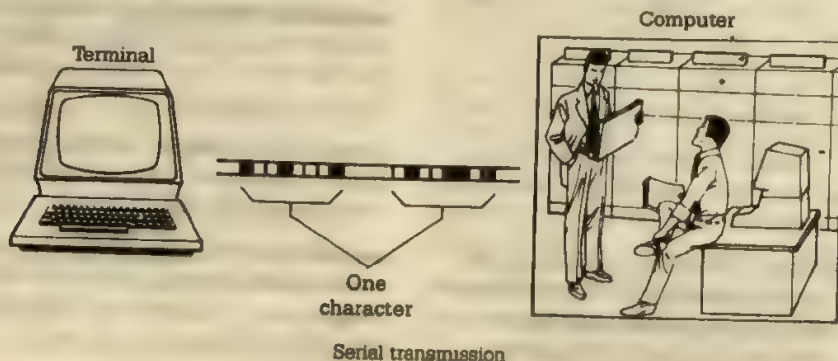
**serial printer** Printer that receives information from the computer one bit at a time through a single wire. (One character equals eight bits). One or more additional wires may be necessary to exchange control signals. Prints one character at a time at speeds up to 600 cps. See *character printer*. Contrast with *parallel printer*.

**serial processing** Reading and/or writing records on a file, one by one, in the physical sequence in which they are stored. See *serial access*. Contrast with *parallel processing*.

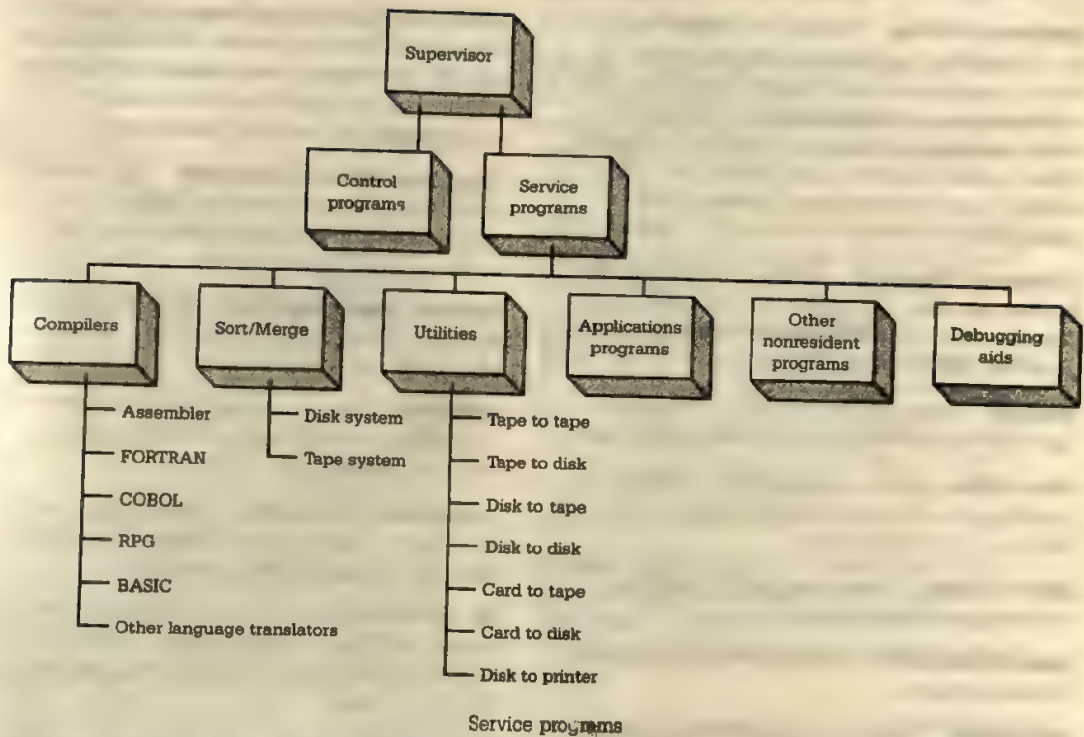
**serial reading** Column-by-column reading of a punched card. Contrast with *parallel reading*.

**serial transmission** Method of data transfer in which the bits composing a character are sent sequentially. Required for telephone data transfer. Contrast with *parallel transmission*.

**service bureau** Organization that provides data processing services for other individuals or organizations. Sometimes called *computer services company*. See *computer utility*.







**service contract** Contract with a computer dealer, computer store, or service company that ensures immediate repair of a computer system

**service programs** Programs that supplement the control programs of an operating system, such as language translators, utility routines, and programmer aids.

**servomechanism** Feedback control system.

**session** Period of time during which a computer system operator works from a terminal at one sitting.

**set** (1) To place a binary cell into the 1 state. (2) To place a storage device into a specified state, usually other than denoting zero or blank. (3) Any collection of related things. (4) In a relational database model, a collection of things. (5) In a network/hierarchical database

model, a one-to-many relationship, the path by which one record type is connected to another.

**SETL** High-level language designed to facilitate the programming of algorithms involving sets and related structures.

**setup** Arrangement of data or devices to solve a particular problem.

**setup time** Time between computer runs or other machine operations that is devoted to such tasks as changing disk packs and moving cards, forms, and other supplies to and from the equipment.

**shade** In computer graphics, the quantity of black mixed with a pure color.

**shading symbols** Block graphics characters that are part of some computer graphics built-in character sets. Provide different dot densities, giving the appearance of different levels of shading.

**shadow printing** Printing of a bold character by backing up the print head to within  $\frac{1}{120}$  inch of its previous position and restriking. The slight amount of misregistration between the initial impression and the overstrike produces a fatter, bolder character. See *boldfacing*, *overstriking*, and *microspacing*. Contrast with *multiple-pass printing*.

**Shannon, Claude E.** Made contributions to Boolean algebra, cryptography, and computing circuits, and to communications with his mathematical theory of information.

**SHARE** Organization of users of medium- and large-scale IBM data processing systems.

**shared file** Direct access device that may be used by two systems at the same time. May link two computer systems.

**shared logic** Concurrent use of a single computer by multiple users.

**shared resource.** Computer resource shared by several users.

**sharpness** Clarity and quality of an image produced on a visual display device, digital plotter, printer, film recorder, and other devices. See *resolution*.

**sheet feeder** Device that attaches to the printer, designed to automatically insert and line up single sheets of paper or envelopes in much the same way as an operator would perform the task. Usually sits above the printer platen and is operated either mechanically or electrically by the printer. See *friction-feed*.

**shielding** Protection against electrical or magnetic noise.

**shift** To move the characters of a unit or information columnwise right or left. For a number, this is equivalent to multiplying or dividing by a power of the base of notation.

**shift-click** To *click* the mouse button while depressing the shift key on the keyboard.

**shift key** Key on a computer keyboard that,

when pressed, makes letters print as capitals instead of lower-case letters and allows some special characters to be printed. On many keyboards, acts as a shift lock and must be pressed again to return to lower case.

**Shockley, William Bradford** Bell Labs scientist who, along with Walter Brattain and John Bardeen invented the *transistor*. Instrumental in inventing *magnetic bubble memory*.

**shortest operating time** Scheduling procedure for scheduling jobs that take the shortest amount of computer time first.

**SHRDLU** First natural-language program that integrated syntactic and semantic analysis with knowledge of the world.

**shutdown** Termination of electrical power to all or part of the computer system components, whether intentional or inadvertent.

**SI** Standard abbreviation of the worldwide international metric system. (From French *Système International d'Unités*— International System of Units).

**side effect** Consistent result of a procedure that is in addition to the basic result.

**sift** To extract certain desired items of information from a large amount of data. Compare *select*.

**sifting** Method of internal sorting by which records are moved to permit the insertion of other records. Also called insertion method. Compare *bubble sort*.

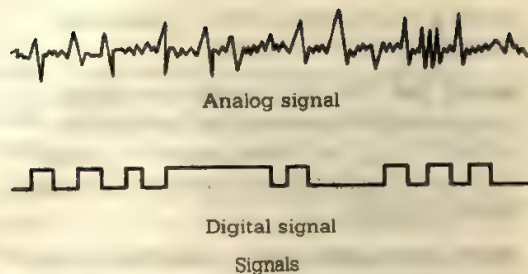
**SIG** Acronym for *Special Interest Group*.

**sign** Used in the arithmetic sense to describe whether a number is positive or negative.

**signal** In communications theory, an intentional disturbance in a communications system. Contrast with *noise*.

**signal-to-noise ratio** In data communications, the ratio of the (wanted) signal to the (unwanted) noise.





**signaling rate** Rate at which signals are transmitted over a communications link.

**sign digit** Digit in the sign position of a word.

**sign extension** Duplication of the sign bit in the higher-order positions of a register. Usually performed on *one's complement* or *two's complement* binary values.

**sign flag** Flip-flop that goes to position 1 if the most significant bit of the result of an operation has the value of 1.

**significant digit** Any digit that contributes to the *precision* of a number. The number of significant digits is counted beginning with the digit contributing the most value, called the *most significant digit*, and ending with the one contributing the least value, called the *least significant digit*.

**sign-off** (1) Process of disconnecting from a time-sharing computer network. (2) Dissolution of any user/computer interface.

**sign-on** (1) Process of getting connected to a time-sharing computer network. (2) Establishment of any user/computer interface.

**sign position** Position at which the sign of a number is located.

**silicon** Nonmetallic chemical element used in the manufacture of transistors, integrated circuits, solar cells, and so forth. Chemical element (atomic number 14) widely found in sand and clay.

**silicon chip** Tiny portion of a *silicon wafer* with thousands of electronic components and circuit patterns etched on its surface.

**silicon-controlled rectifier (SCR)** Semiconductor device that, in its normal state, blocks a voltage applied in either direction.

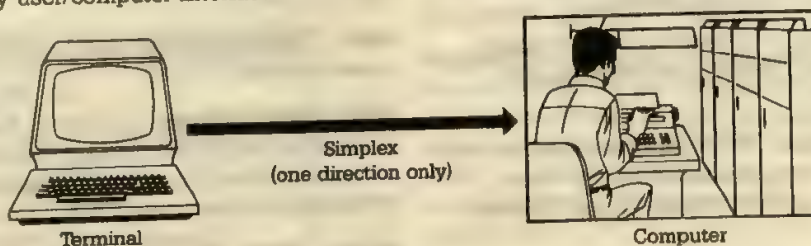
**Silicon Valley** Nickname for an area south of San Francisco noted for its large number of electronic, semiconductor, and computer manufacturing firms. Also known as Silicon Gulch.

**silicon wafer** Silicon slice on which integrated chips are fabricated. After fabrication, the wafer is cut into many individual chips, which are then mounted in *dual in-line packages*.

**simplex** Pertaining to a communications link capable of transmitting data in only one direction. Contrast with *full-duplex* and *half-duplex*.

**SIMSCRIPT** High-level programming language specifically designed for simulation applications.

**simulation** Representation of certain features of the behavior of a physical or abstract system by the behavior of another system, such as the representation of physical phenom-



Simplex

ena by means of operations performed by a computer, or the representation of operations of a computer by those of another computer.

**simulator** Device, computer program, or system that represents certain features of the behavior of a physical or abstract system. For example, a computer-controlled aircraft simulator is used by most airline companies to train pilots.

**simultaneous input/output** Process in which some computer systems allow new information to be input while other information is being output.

**simultaneous processing** Performance of two or more data processing tasks at the same instant. Contrast with *concurrent processing*.

**single address** See *one-address instruction*.

**single-board computer** Computer that contains all its circuitry on one board, including the CPU, ROM, RAM, and peripheral interfaces.

**single density** Method of storing data on a diskette. See *double density*.

**single precision** Pertaining to the use of one computer word to represent a number. Contrast with *double precision* and *triple precision*.

**single-sided disk** Diskette with only one side used for reading and writing information. Contrast with *double-sided disk*.

**single step** Operation of a computer in such a manner that only one instruction is executed each time the computer is started.

**SI units** Units of measure in the international metric system. See *SI*. Contrast with *engineering units*.

**sixteen-bit chip** Microprocessor chip that processes information sixteen bits at a time. Contrast with *eight-bit chip* and *thirty-two-bit chip*.

**sketching** Computer graphics technique in

which a trail of lines is drawn or sketched along the path of the cursor.

**sketch pad** Working storage area displayed on a visual display screen that permits the operator to add and delete graphic or textual information easily before it is entered into permanent storage.

**skew** In computer graphics and optical scanning, a condition in which a character, line, or reprinted symbol is neither parallel with nor at right angles to the leading edge. See *stair stepping*.

**skip** To ignore one or more instructions in a sequence of instructions.

**SLA** Acronym for *Special Libraries Association*.

**slab** Part of a word.

**slack time** See *float*.

**slave** Device controlled by another device.

**slave tube** Cathode ray tube connected to another in such a way that both tubes perform identically.

**sleeve** Protective envelope for storing a diskette.

**slew** To move paper through a printer.

**slewing** Pertaining to the speed at which numerically controlled machine tools move from one position to another.

**slice** Special type of chip architecture that permits the cascading of devices to increase word bit size.

**slide** Photographic representation of a visual screen display.

**slide show package** Computer graphics software package that displays the graphics in a timed sequence on the video display screen, similar to a slide show.

**slope** Rate at which a curve rises or falls per horizontal unit.



**slot** Single board position in a *backplane*.

**SLSI** Acronym for *Super Large Scale Integration*.

**SLT** Acronym for Solid Logic Technique, term coined by IBM to refer to a microelectronic packaging technique for producing a circuit module.

**slug** Metal casting that carries the image of a printable character. Prints by striking the paper.

**small business computer** Stand-alone data processing system built around a digital computer system dedicated to the processing of standard business applications, such as payroll, accounts receivable and payable, order entry, inventory, and general ledger.

**small scale integration (SSI)** Class of integrated circuits that has the fewest number of functions per chip. Compare *medium scale integration*, *large scale integration*, and *very large scale integration*.

**SMALLTALK** Language and software system designed to make computer use as easy as possible for the layperson. Presents possible choices of operation in the form of pictures or *icons* on the screen. The user selects one by moving a pointer with the aid of a *mouse* to the appropriate position and then presses a button on top of the mouse to inform the computer of the choice. SMALLTALK systems are characterized by a high degree of pictorial interaction.

**smart** Having some computational ability of its own. Smart devices usually contain their own microprocessors.

**smart card** Credit card with a built-in computer.

**smart machines** Machines that use microprocessors as their control elements.

**smart terminal** Terminal that contains some capacity to process information being transmitted or received, although not as much as an

*intelligent terminal*. See *local intelligence*. Contrast with *dumb terminal*.

**smash** To destroy an area of storage by overwriting with another program.

**SMIS** Acronym for Society for Management Information Systems, a professional organization for fostering improved management performance and information exchange.

**smooth** To apply procedures that decrease or eliminate rapid fluctuations in data.

**smooth scrolling** Ability to scroll text without it jerking from one line to the next.

**SNA** Acronym for Systems Network Architecture.

**snapshot dump** *Dynamic dump* of the contents of specified storage locations and/or registers performed at specified points or times during the running of a program. Contrast with *post mortem dump*.

**SNOBOL** Acronym for StriNg-Oriented symbolic Language, developed by Bell Laboratories. Has significant applications in program compilation and generation of symbolic equations. Unique language that provides complete facilities for the manipulation of strings of characters. Particularly applicable to programs associated with text editing, linguistics, compiling, and symbolic manipulation of algebraic expressions.

**SO** Acronym for Send Only, a designation used to indicate the send-only capabilities of equipment. Contrast with *receive only*.

**Society for Computer Simulation (SCS)** Only technical society devoted primarily to the advancement of simulation and allied technologies, notably those dealing with management, social, scientific, biological, and environmental problems. Has a worldwide membership.

**Society of Certified Data Processors (SCDP)** Organization that represents the interests and wishes of certified computer profes-

## soft clip area

sionals, formed in 1971. Members control what positions, actions, and directions the organization takes. Only organization exclusively representing interests of ICCP certificate holders.

**soft clip area** Limits of the area where data can be presented on a plotting device.

**soft copy** Data presented as a video image, in audio format, or in any other form that is not *hard copy*.

**soft fails** Noise bursts in microelectronic circuits caused by cosmic-ray particles may result in spontaneous changes in the information stored in computer memories. These changes are called soft fails. This sensitivity to cosmic rays is one of the unanticipated results of the ever-decreasing size of the components of integrated microelectronic circuits, and it presents new considerations in the development of very large scale integrated circuits.

**soft hyphen** Conditional (nonrequired) hyphen printed only to break a word between syllables at the end of a line. Contrast with *hard hyphen*.

**soft keys** Keys on a keyboard that can have a user-defined meaning. Called soft keys because their meaning can change from user to user or program to program.

**soft return** Combination line feed/carriage return command, entered by a program containing the *word wrap* feature to begin a new line within a paragraph. Unlike a hard return, it is conditional—the computer executes the command only when the current word doesn't fit in the line in progress.

**soft sector** Method of marking sectors or sections on a disk by using information written on the disk. Method of determining positioning of data on the disk by software calculations rather than by physical monitoring of the disk. Contrast with *hard sector*.

**software** Term coined to contrast with the "iron" or *hardware* of a computer system. Sets of programs (stored sets of instructions) that

govern the operation of a computer system and make the hardware run. The software for a computer system may be classified as *applications programs* and *systems programs*. See *custom software*, *canned software*, *courseware*, *firmware*, and *freeware*.

**software base** Software available for a particular computer system. The broader the software base, the more versatile the computer system.

**software broker** Individual who specializes in marketing software packages.

**software company** *Software house*.

**software compatability** Ability to use programs written for one system on another system with little or no change.

**software development** Creation of sets of programs that meet the requirements of a user.

**software documents** Written or printed material associated with computer equipment and software systems.

**software encryption** Encoding or decoding of computerized data by using programming techniques rather than hardware devices, such as scramblers.

**software engineering** Term coined in 1967 by the Study Group on Computer Science of the NATO Science Committee to imply the need for software manufacture based on the types of theoretical foundations and practical disciplines traditional in established branches of engineering. Concerned with the development and implementation of large-scale software systems on production-model computers. Encompasses a broad range of topics related to the controlled design and development of high-quality computer software, including programming methodology—such as *structured programming*, *egoless programming*, software quality assurance, and programming productivity aids—and management of software projects—such as *structured walkthroughs*, *chief programmer teams*, program support library, and



**HIPO technique.** Contrast with *computer engineering*.

**software flexibility** Property of software that enables it to change easily in response to different user and system requirements.

**software house** Company that offers both general software packages and specific software packages for sale to computer systems owners. See *packaged software*.

**software librarian** Person in charge of a large collection of software (usually on disk packs, diskettes, or magnetic tapes) in a company. See *custodian*.

**software license** Contract signed by the purchaser of a software product in which he/she is usually made to agree not to make copies of the software for resale.

**software maintenance** Ongoing process of detecting and removing errors from existing programs. Done by *maintenance programmers*.

**software monitor** Program used for performance measurement purposes.

**software package** Collection or set of related computer programs. Usually includes the programs, stored on a storage media (floppy disk, cassette, and so on), and documentation or a *tutorial*.

**software piracy** Copying of commercial or proprietary software without permission of the originator.

**software portability** Ease with which a program can be moved from one computer environment to another. As third-party software becomes more prevalent in the computer industry, portability becomes a more valuable attribute of that software.

**software product** Vendor package comprising programs, data, documentation, and sometimes vendor assistance. Also called *programming product*.

**software protection** Resistance to unauthorized copying of software. See *software piracy*.

**software publisher** Business that publishes and sells software packages.

**software resources** Program and data resources that represent the software associated with a computing system.

**software science** Discipline concerned with the measurable properties of computer programs.

**software system** Entire set of computer programs and their documentation, as used in a computer system.

**software transportability** Ability to take a program written for one computer and run it without modification on another computer. See *software portability*.

**solar cell** Semiconductor electrical junction device that absorbs and converts the radiant energy of sunlight directly and efficiently into electrical energy.

**solicitation** Request to vendors to submit bids for hardware, software, or services. See *request for proposal* and *request for quotation*.

**solid state** Descriptive of electronic components whose operation depends on the control of electric or magnetic phenomena in solids, such as *integrated circuits* and *transistors*.

**solid state cartridge** Preprogrammed plug-in module used with several microcomputer systems. See *cartridge*, *firmware*, and *ROM cartridge*.

**solid state device** Device built primarily from solid state electronic circuit elements.

**S-100 bus** Standard means of interconnection between some microcomputers and peripheral equipment. So named because popularity made it standard, and it has 100 electrical contacts.

**son file** See *father file*.

**SOP** Acronym for *Standard Operating Procedure*, the status quo.

**sort** (1) To arrange records according to a logical system. On a computer, most sorting is done by using magnetic disks or tapes. (2) Utility program that sorts records held on disk or tape.

**sort effort** Number of steps needed to order an unordered list.

**sorter** Device that arranges a set of card records in a preselected sequence.

**sort generator** Program that generates a sort program for production running.

**sorting** Process of arranging data according to a logical system.

**sort/merge program** Generalized processing program that can be used to sort or merge records in a prescribed sequence.

**SOS** Acronym for Silicon On Sapphire, the process of fabricating integrated chips on layers of silicon and sapphire.

**sound hood** Device that fits over a printer during use to dampen noise. Also called *acoustical sound enclosure*.

**source** One of three terminals or electrodes of a *field effect transistor*. Origin of the charge carriers that flow past the *gate* to the *drain*.

**source code** Symbolic coding in its original form before being processed by a computer. The computer automatically translates source code into a code the computer can understand.

**source computer** Computer used to translate a source program into an object program.

**source-data automation** Process whereby data created while an event is taking place is entered directly into the system in a machine-processable form. See *point-of-sale terminal* and *transaction-oriented processing*.

**source deck** Card deck comprising a computer program in *source language*. Contrast with *object deck*.

**source disk** Disk from which a file or pro-

gram is copied. Contrast with *target disk*.

**source document** Any original document from which basic data is extracted, such as an invoice, a sales slip, or an inventory tag.

**source language** Any *low-level language*, such as assembly language, or any *high-level language*—such as BASIC, FORTRAN, or COBOL—in which a *source program* is written.

**source media** Checks or other *source documents* from which raw data is derived. Compare *input media* and *output media*.

**source program** Computer program written in a source language, such as BASIC, FORTRAN, COBOL, Pascal, or assembly language. It is converted to the machine-code *object program* by a special processing program, such as a *compiler* or *assembler*.

**source register** Register that contains a data word that is being transferred.

**Source (The)** Information utility service available to subscribers, operated by The Source Telecomputing Corporation. Allows users with computers and modems to play games, access databases, check flight schedules, post messages, receive and send electronic mail, read newspaper wire services, and a host of other things. Personal computer users can use The Source network via a common telephone hookup. Compare *Compu-Serve*.

**SPA** Acronym for Systems and Procedures Association, a professional organization whose purpose is to promote advanced management systems and procedures through seminars, professional education, and research.

**space** (1) One or more blank characters. (2) State of a communications channel corresponding to a binary zero.

**spacebar** At the bottom of a keyboard, the long, narrow key that generates spaces. When pressed once, it causes a space to be placed into text at the insertion point.



**spaghetti code** Program that contains excessive GOTO statements. The term was first used by Edsger Dijkstra.

**span** Difference between the highest and lowest values in a *range* of values.

**spanning tree** Subgraph of a graph with two properties: (a) it is a tree, and (b) it contains all the nodes of the original graph.

**sparse array** Array in which most of the entries have a value of zero.

**spatial data management** Technique that allows users access to information by pointing at pictures on a display screen, representing databases, document files, or any category of information.

**spatial digitizer** Device often used in computer graphics to simulate three-dimensional objects.

**spec** Abbreviation for specification. More often *specs*.

**special character** Graphics character that is neither a letter, a digit, nor a blank; for example, plus sign, equal sign, asterisk, dollar sign, comma, period, and so on.

**special function key** Key on a keyboard to control a mechanical function, initiate a specific computer operation, or transmit a signal that would otherwise require multiple key strokes.

**Special Interest Group (SIG)** Any special group within an organization that holds meetings, sponsors exhibits, and publishes documents related to some special interest, topic, or subject. The Association for Computing Machinery (ACM) has more than thirty SIGs. These groups elect their own officers, set their own dues, and are self-supporting.

**Special Libraries Association (SLA)** International organization of libraries and information specialists that promotes the establishment of resource centers for various interest groups, such as banks, museums, and law firms.

**special-purpose** Being applicable to a limited class of uses without essential modification. See *dedicated*. Contrast with *general-purpose*.

**special-purpose computer** Computer designed for solving only a few selected types of numerical or logical problems. Uses range from automobiles, cameras, and home appliances to monitoring flights of space shuttles. Contrast with *general-purpose computer*.

**special-purpose programming language** Programming language designed to handle one specific type of problem or application.

**specification** Detailed description of the required characteristics of a device, process, or product.

**specification sheet** Form used for coding RPG statements.

**specs** Specifications.

**speech recognition** Ability of a computer to match the pattern of signals coming into it from a "microphone" with stored voice patterns held in its memory and thus recognize spoken words.

**speech synthesis** Arranging of coded speech components into real words and sentences. Constructs words from *phonemes*.

**speech synthesizer** Device that converts numerical code into recognizable speech, which is played over a loudspeaker. Peripheral that converts output signals into an artificial human voice that "speaks." See *digital speech*.

**speed of light** Speed at which light travels—186,284 miles per second. Limiting factor in the speed of data transmissions within and between computers and peripherals.

**spelling checker** Computer program, usually associated with word processing, that compares typed words against a word list and informs the user of possible spelling mistakes. Also called *dictionary program* and *proofing program*.

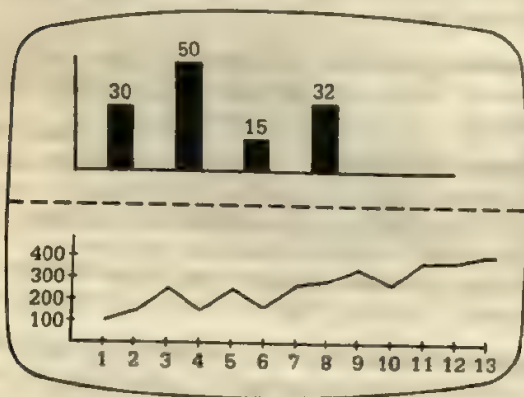
**spider configuration** Type of distributed system in which a central computer system is used to monitor the activities of several network computer systems.

**spike** Sharp-peaked, short-duration voltage transient. Brief sudden *surge* of electricity.

**spinwriter** Particular type of high-quality computer printer. See *thimble printer*.

**spline** In computer graphics, a piecewise polynomial with at least first-order continuity between the pieces. Mathematically simple and elegant way to connect disjoint data points smoothly, hence used not only for generating smooth curves and surfaces between sparse data points, but also for smooth motions between parameters sparsely located in time, such as those used to describe the keyframes in an animation.

**split screen** Display screen that can be partitioned into two or more areas (*windows*) so different screen formats can be shown on the screen at the same time.



Split screen

**splitting a window** Act of dividing a *window* into two or more *panes*.

**split window** Same as *split screen*.

**spool** (1) Reel of magnetic tape. (2) To wind a magnetic tape.

**spooler** Program or peripheral device that allows a computer to produce hard copy on a printer while doing something else.

**spooling** (1) Process by which various input/output devices appear to be operating simultaneously, when actually the system is inputting or outputting data via *buffers*. (2) Temporarily storing data on disk or tape files until another part of the system is ready to process it.

**spreadsheet** Any one of a number of programs that arrange data and formulas in a matrix of cells. Has wide range of business uses, including *What if?* considerations. *VisiCalc* is the best-known of the commercial spreadsheets. Also called *plansheet* and *worksheet*.

**sprites** Small, high-resolution objects that can be moved independently of other text or graphics on the monitor. They can change color and size and move in front of or behind other objects on the monitor. Used to create animated sequences.

**sprocket holes** Equally spaced holes on both edges of continuous forms for use by a *tractor-feed mechanism* to feed paper through a printer.

**squeezer** Person who lays out the LSI circuit in its original "large" form.

**SSI** Acronym for *Small Scale Integration*

**stack** Sequential data list stored in internal storage. Rather than addressing the stack elements by their memory locations, the computer retrieves information from the stack by popping elements from the top (*LIFO*) or from the bottom (*FIFO*). See *program stack* and *stack pointer*.

**stacked job processing** Technique that permits multiple jobs to be stacked for presentation to the system and automatically processes the jobs, one after the other. A series of jobs to be executed is placed in a card reader. The computer system executes the jobs automatically in accordance with the job control cards for each job.



**stacker** See *card stacker*.

**stack pointer** Register used to point to locations in the stack. Incremented by one before each new data item is pulled or popped from the stack, and decremented by one after a word is pushed onto the stack. See *stack*, *pop*, and *push*.

**stair stepping** Technique used on raster displays to represent a line drawn at any angle other than 45 degrees, horizontal, or vertical. Compare *skew*.

**stand-alone** Descriptive of a single, self-contained computer system, as opposed to a terminal that is connected to and dependent upon a remote computer system. A stand-alone device will operate by itself, requiring no other equipment.

**stand-alone graphics system** Graphics system that includes a microcomputer or mini-computer, storage, video display terminal, and other input/output devices.

**stand-alone system** Self-contained computer system that can work independently, not connected to or under the control of another computer system.

**standard** (1) Guide used to establish uniform practices and common techniques. (2) Yardstick (meterstick!) used to measure performance of any computer system function. May be laid down by a statutory body or simply created by a major manufacturer's practice. See *ANSI*.

**standard interface** Standard physical means by which all peripheral devices are connected to the central processing unit, such as a standard form of *plug and jack*. See *RS-232C*.

**standardize** To establish standards or to cause conformity with established standards.

**standards enforcer** Computer program used to determine automatically whether prescribed programming standards and practices have been followed.

**standby equipment** Duplicate set of equipment to be used as *backup* if the primary unit becomes unusable because of malfunction.

**standby time** (1) Period between placing an inquiry into the equipment and the availability of the reply. (2) Period between the setup of the equipment for use and its actual use. (3) Period during which equipment is available for use but is not being used.

**star network** Network configuration consisting of a central host computer and satellite terminals that connect to the computer to form a star pattern. The remote terminals may be geographically widespread. Also called a *centralized network configuration*. Contrast with *ring network*. (See page 276.)

**start bit** (1) Bit or group of bits that identifies the beginning of a data word. See *group mark*. (2) Bit indicating the beginning of an asynchronous serial transmission. Contrast with *stop bit*.

**startup** Process of setting computer system devices to proper initial conditions and applying appropriate electrical power.

**startup disk** Diskette that contains the information to start the computer system.

**stat** Abbreviation for statistical or photostat.

**state** Condition of bistable devices used to represent binary digits. By definition, such devices can have only two states; the state of a switch describes whether it is on or off.

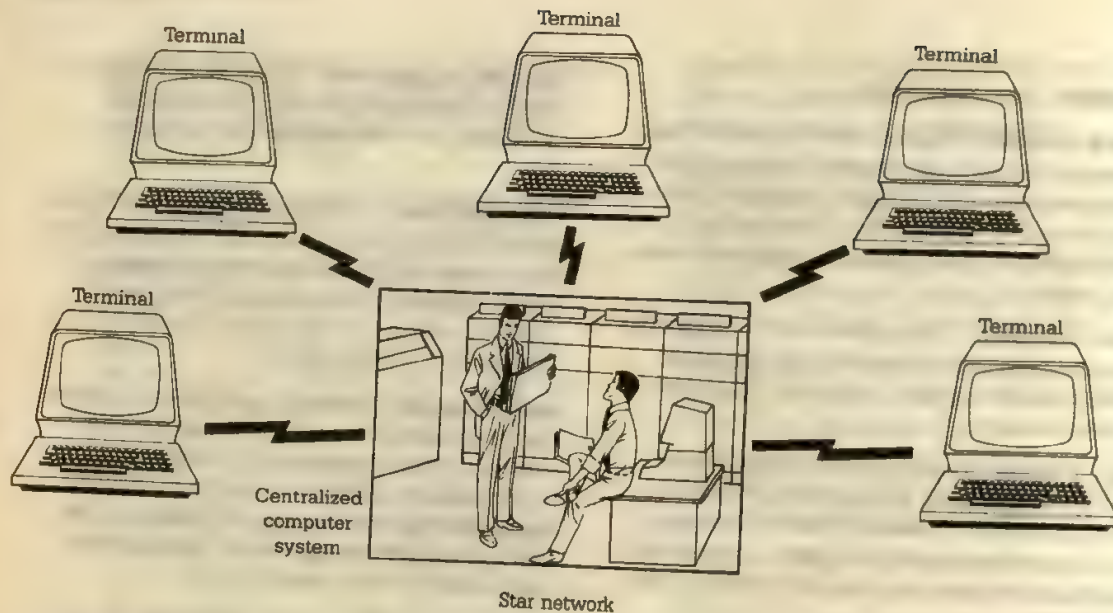
**statement** Expression of instruction in a computer language.

**statement label** Line number of a statement in a source-language program.

**state-of-the-art** Phrase that implies being up-to-date in technology. Pertaining to the very latest technology, an ephemeral condition.

**static** Not moving or progressing; stationary; at rest.

## static analysis



**static analysis** Analysis of a program performed without executing the program.

**static dump** Storage dump performed at a particular point in time with respect to a machine run, often at the termination of a run. See *post mortem dump*. Contrast with *dynamic dump*.

**staticizing** Process of transferring an instruction from computer storage to the instruction registers and holding it there, ready to be executed.

**static memory** Memory that retains its programmed state as long as power is applied. Does not need to be refreshed, and does not require a clock. See *nonvolatile storage*.

**static RAM** Memory that doesn't need to be refreshed many times a second, as is required with *dynamic RAM*. Does not lose its contents as long as power to the computer is on. Once the computer puts a value into a *static memory* location, it remains there.

**static refresh** Method of processing data stored temporarily in a remote *intelligent terminal* rather than in the central processing computer. Permits faster editing of data because

data need not be transferred back and forth between the remote terminal and the host computer.

**static storage** Specific type of semiconductor memory that does not require periodic refresh cycles. Data are held by changing the position of an electronic switch, a transistor *flip-flop*, contained in integrated circuits.

**station** One of the input or output points on a data communications system. Synonymous with *workstation*. See *terminal*.

**statistics** Branch of mathematics that collects information and tabulates and analyzes it.

**status** Present condition of a system component.

**status report** Analysis of actual project costs and time expended against the plan, with variances calculated and displayed.

**step** (1) To cause a computer to execute one instruction. (2) One instruction in a computer routine.

**stepped motor** Mechanical device that rotates by a fixed amount each time it is pulsed. Often used in disk drives and digital plotters.



**Stibitz, George** In the design of his *analytical engine*, Charles Babbage listed four elements a machine had to include to perform the functions of a human computer: an arithmetic unit; a memory; automatic "choice" of computing sequence; and input and output. In 1946, George Stibitz, then a research mathematician with Bell Telephone Laboratories, designed several relay calculators that incorporated the ideas of Babbage. See *Babbage, Charles*.

**stochastic procedures** Trial and error, as opposed to algorithmic procedures.

**stochastic process** Any process dealing with events that develop in time or space and that cannot be described precisely, except in terms of *probability theory*.

**stop bit** (1) Bit or group of bits that identifies the end of a data word and defines the space between data words. See *group mark*. (2) Bit indicating the end of an asynchronous serial transmission. Contrast with *start bit*.

**stop code** Specific control character.

**storage** Descriptive of a device or medium that can accept data, hold it, and deliver it on demand at a later time. The term is preferred over *memory*. See *auxiliary storage*, *internal storage*, *PROM*, *protected storage*, *RAM*, and *ROM*.

**storage allocation** Assignment of specific programs, program segments, and/or blocks of data to specific portions of a computer's storage. Sometimes called memory allocation. See *program storage*.

**storage block** Contiguous area of internal storage.

**storage capacity** Number of items of data that a storage device is capable of containing. Frequently defined in terms of computer bytes (K bytes or M bytes) or words (K words).

**storage circuit** Circuit that can be switched into either of two stable states, 0 or 1.

**storage device** Device used for storing data within a computer system, such as integrated circuit storage, magnetic disk unit, magnetic tape unit, magnetic drum unit, floppy disk, and tape cassette

**storage dump** Printout of all or part of the contents of the internal storage of a computer. Often used to diagnose errors. Also called *memory dump*. See *post mortem dump* and *snapshot dump*.

**storage key** Indicator associated with a storage block or blocks; it requires that tasks have a matching protection key to use the blocks. See *privileged instruction* and *storage protection*.

**storage location** Position in storage where a character, byte, or word may be stored. Same as *cell*.

**storage map** Diagram that shows where programs and data are stored in the storage units of the computer systems. Also called *map*. (See page 278.)

**storage pool** Group of similar storage devices; disk drives in a computer installation are collectively referred to as the disk pool.

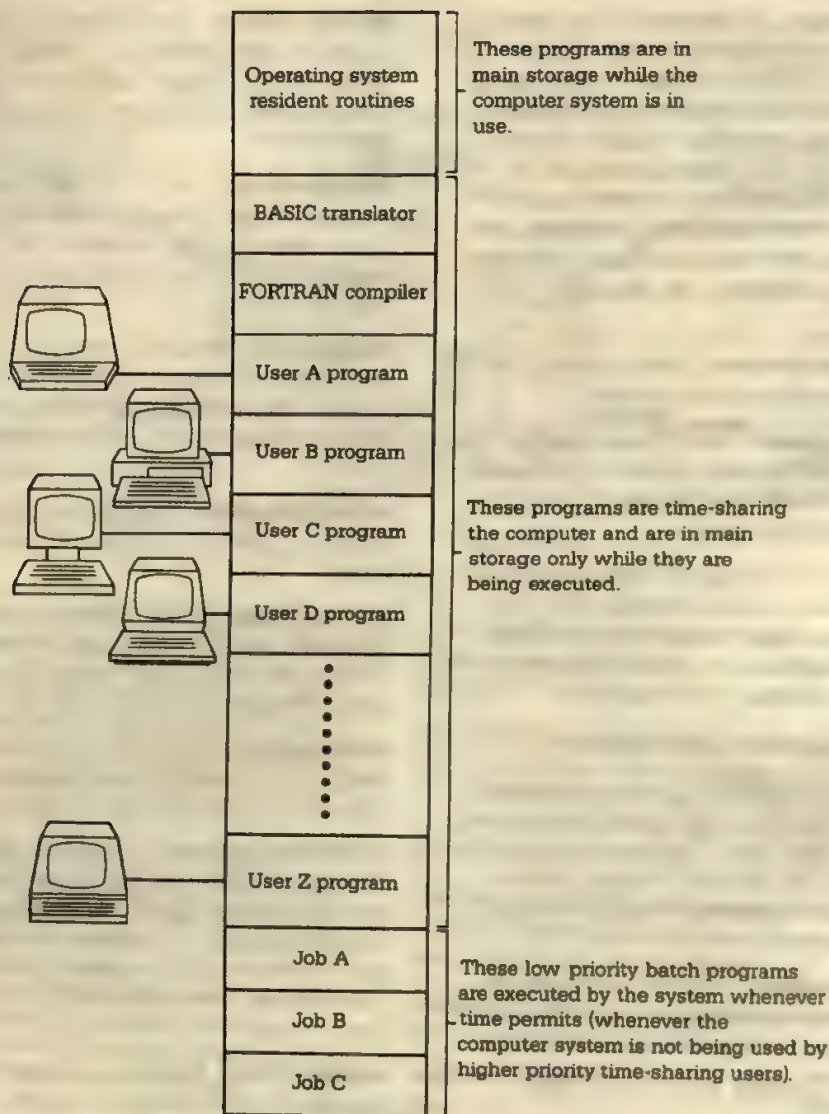
**storage protection** Protection against unauthorized writing in and/or reading from all or part of a storage device. Generally implemented automatically by hardware facilities, usually in connection with an operating system. Sometimes called memory protection. See *storage key*.

**storage tube** Electron tube into which information can be introduced and then extracted at a later time. Used in *first generation computers*.

**storage unit** See *storage device*.

**store** (1) British term for storage (2) To place in storage.

**store-and-forward** In data communications, the process-handling messages used in a message-switching system.



Storage map

**stored-program computer** Computer capable of performing sequences of internally stored instructions and usually capable of modifying those instructions as directed by the instructions. Same as *digital computer*.

**stored-program concept** Instructions to a computer as well as data values are stored within the internal storage of a computer. The

instructions can thus be accessed more quickly and may be more easily modified. This concept, introduced by John von Neumann in 1945, is the most important characteristic of the digital computer. See *von Neumann, John*.

**straight-line code** Repetition of a sequence of instructions by explicitly writing the instructions for each repetition. Generally, straight-



line coding will require less execution time and more storage space than equivalent loop coding. Feasibility is limited by the space required as well as by the difficulty of coding a variable number of repetitions. Contrast with *loop code*.

**streamer** Tape deck that operates at a continuous high speed rather than starting and stopping between separate blocks of data.

**streaming tape drive** Device that holds a continuous tape cartridge and is used primarily for backup of hard disk drives.

**STRESS** Acronym for STRuctural Engineering System Solver, a problem-oriented language used for solving structural engineering problems.

**stress testing** Ensuring through trial operation that the program or system will continue to perform reliably in spite of data inaccuracies and extraordinary data volumes.

**string** Connected sequence of characters or bits treated as a single data item. The word "windsurfer" is a string of ten characters.

**string handling** Ability of a programming language to operate on strings of characters.

**string length** Number of characters in a string.

**string manipulation** Technique for manipulating strings of characters.

**string processing languages** Programming languages designed to facilitate the processing of strings of characters, such as COMMIT, SNOBOL, AMBIT, CONVERT AXLE, PANON, and EOL.

**string variable** String of alphanumeric strings.

**stringy floppy** Computer storage device that holds a magnetic tape, called a wafer. The enclosed wafer tape is thinner, narrower, and faster than conventional cassette tapes.

**stroke** (1) *Keystroke*. (2) In a computer graphics system, textual data stored as a

graphical entity rather than as ASCII character symbols.

**stroke writer** Vector graphics terminal that represents objects on a screen by a series of lines (vectors).

**structural design** Overall organization and control logic of processing.

**structure** Organization or arrangement of the parts of an entity. Manner in which a program is organized.

**structure chart** Design tool for documenting the organization or program modules and the control logic that relates them to one another. Graphic representation of *top-down programming*.

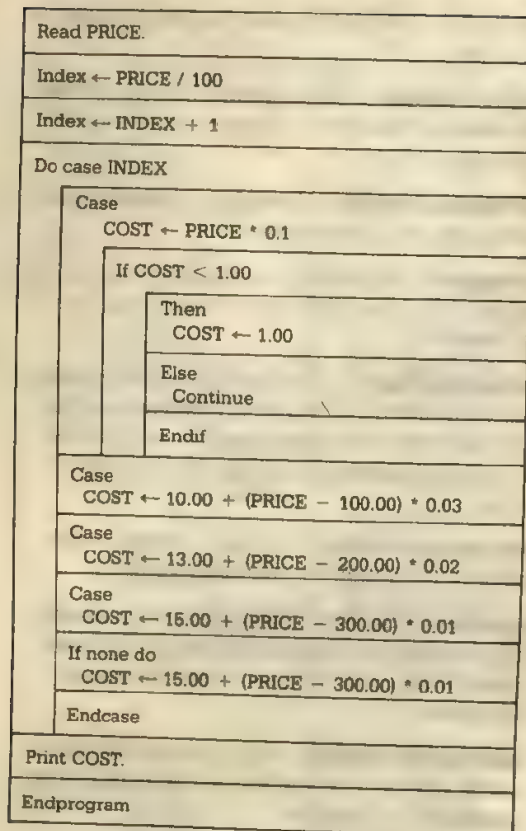
**structured coding** Method of writing programs with a high degree of structure.

**structured design** Methodology for designing programs and systems through top-down, hierarchical partitioning and logical control structures.

**structured English** Approach to languages that is based on replacing symbols with recognizable English words.

**structured flowchart** Method of representing problem solutions in terms of three flowcharting structures: the *sequence structure*, the *selection structure*, and the *loop structure*. (See page 280.)

**structured programming** Programming technique that assumes the disciplined use of a few basic coding structures and the use of top-down concepts to decompose main functions into lower-level components for modular coding purposes. Concerned with improving the programming process through better organization and programs, and with better programming notation to facilitate correct and clear descriptions of data and control structures. The physical structure of a well-organized program corresponds to the sequence of steps in the algorithm being



Structured flowchart

implemented. Good languages for structured programming must have a carefully thought-out assortment of control structures and data-structure definition facilities. Good practices lead to reduced cost of program modification and maintenance as well as original development. See *modular programming*.

**structured walkthroughs** Technical conferences or reviews intended to analyze design, detect errors, and exchange knowledge and ideas. All technical members of the project team have their work product technically reviewed with emphasis on error detection. Facet of *egoless programming*.

**STRUDL** Acronym for STRUctural Design

Language, a programming language used for the design and analysis of structures.

**stub testing** Top-down module testing process that involves using a small dummy-program module inserted and called in a larger program at the location of and in lieu of another routine. The stub may be as simple as one statement or one instruction; for example, RETURN.

**stylus** Pen-shaped instrument used with input devices, such as a pen-like device used with a *graphics tablet*.

**subdirectory** File that lists the names of other files, and is displayed in a disk directory rather than the name of each file. This system allows files to be classified together to save space in a disk directory.

**subprogram** Segment of a program that can perform a specific function. Can reduce programming time when a specific function is required at more than one point in a program. If the required function is handled as a subprogram, the statements for that function can be coded once and executed at the various points in the program. *Subroutines* and functions may be used to provide subprograms

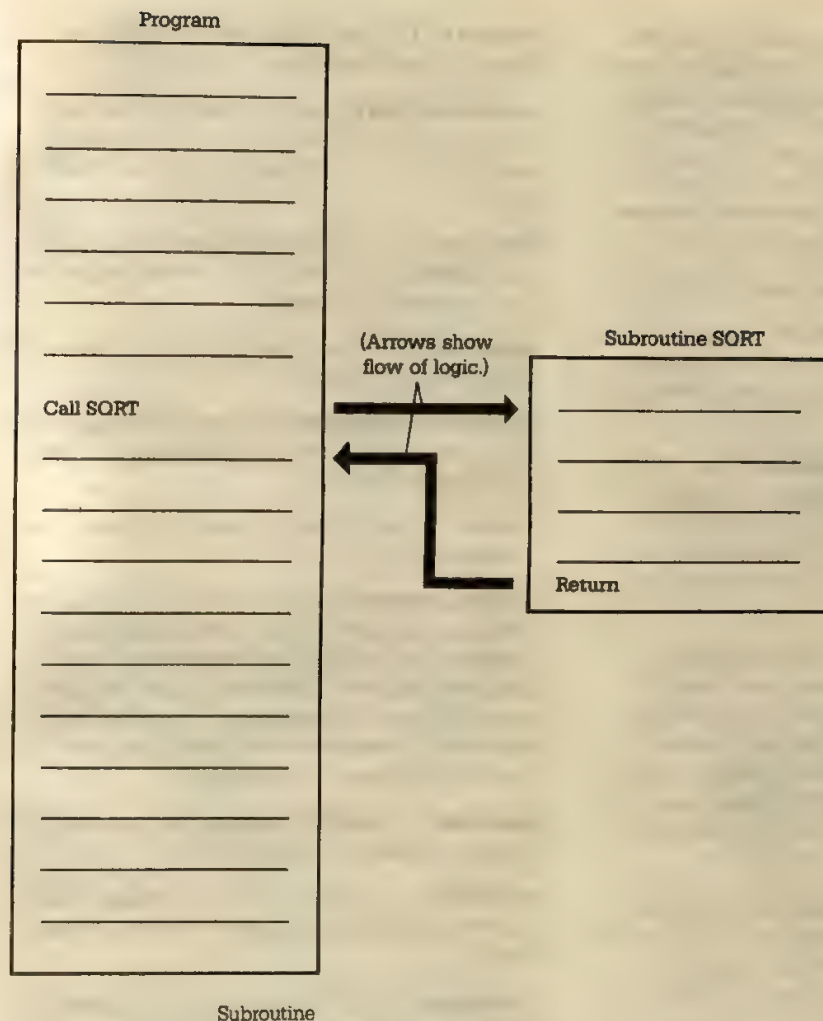
**subroutine** Subsidiary routine within which initial execution never starts. Executed when called by some other program, usually the main program. Also called *subprogram*. See *closed subroutine*, *open subroutine*, and *nested subroutine*.

**subroutine reentry** Initiation of a subroutine by one program before it has finished its response to another program that called for it. May happen when a control program is subjected to a priority interrupt.

**subschemata** Logical organization of data required for a particular program. Contrast with *schema*.

**subscript** (1) Integer value, appended to a variable name, that defines the storage elements composing an array or a *matrix*. (2) In





noncomputer typefonts, a letter or digit written below and to the right of a symbol to distinguish it from variations of the same symbol, such as  $\Theta_a$  and  $\Theta_b$ . Contrast with *superscript*.

Subscripts

CH<sub>ESS</sub> (8, 3)

Subscript

**subscripted variable** Symbol whose numeric value can change, denoted by an array name

followed by a subscript, such as CH<sub>ESS</sub> (2,4) or A(7). See *subscript* and *variable*.

**subset** Any set contained within another set.

**substrate** In microelectronics, the physical material on which a circuit is fabricated.

**substring** Portion of a character string.

**subsystem** System subordinate to the main system.

**suite** Set or group of closely related programs.

**supercomputer** Largest, fastest, and most expensive mainframe computer available. Used by businesses and organizations that require extraordinary amounts of computing power. Sometimes called *number crunchers* because they perform hundreds of millions of operations per second. Some of the newer computers perform over a billion operations per second.

**superconductor** Ultra-fast electronic circuit.

**superconducting computers** High-performance computers whose circuits employ superconductivity and the Josephson effect to reduce cycle time.

**super large scale integration** Use of ultrahigh-density chips that contain one million or more components per chip. Compare *small scale integration*, *medium scale integration*, *large scale integration*, and *very large scale integration*.

**superminicomputer** Minicomputer that uses 32-bit words. The longer word length leads to increased throughput, more precise computations, and easier program development. The processing power of a superminicomputer approaches that of a large-scale mainframe computer. Contrast with *minimicomputer* and *midminicomputer*.

**SuperScripsit** Software package used for word processing on Radio Shack TRS-80 microcomputer systems. Advanced version of the *Scripsit* word processing program. See *word processor*.

**superscript** Letter or digit written above and to the right of a symbol to denote a power or to identify a particular element of a set, such as the 3 in  $x^3$ . Contrast with *subscript*.

**supervisory system** See *operating system*.

**supply company** Company that offers a number of supplies that may not be produced and distributed by computer manufacturers, such as printer paper, printer ribbons, and diskettes.

**support** Help and verbal advice that a vendor supplies a customer.

**support library** Library that contains complete programs and subroutines that have already been developed, tested, and documented.

**suppress** To eliminate leading zeros or other insignificant characters from a computer printout. See *zero suppression*.

**suppression** Elimination of some undesired components of a signal.

**surface of revolution** Figure resulting from the rotation of a curve around a fixed axis set at a specified angle

**surge** Sudden sharp increase in voltage. Also called a *spike*.

**surge protector** Device that protects electrical equipment from being damaged by short surges of high voltage by filtering them out. A computer or other device is plugged into the surge protector, which itself is plugged into a standard 110-volt electrical outlet. See *line surge* and *transient suppressors*.

**surging** Sudden and momentary changing of voltage or current in a circuit.

**suspend** To halt a process in a manner that allows resumption, perhaps by a *system interrupt*

**swapping** (1) In virtual storage, bringing a new page into internal storage from auxiliary storage and replacing an existing page. (2) In a time-sharing system, bringing the program into internal storage or storing it on a storage device. (3) Transferring out a copy of what is in internal memory to auxiliary storage while simultaneously transferring into internal memory what is in auxiliary storage.

**swarm** Several program bugs.

**swim** Situation in which the images displayed on a video display screen move due to



some hardware instability or defect, such as a slow refresh rate. Undesirable movement of an image on a video display screen.

**switch** (1) In programming, a point at which a program may branch to one or more different program statements, depending upon the conditions of specified parameters at that point. (2) Physical or electronic means of changing the state of a component or device, such as an on/off toggle switch.

**switched line** Typically, a telephone line connected to the switched telephone network. Synonymous with *dial-up line*.

**switched lines** Data communication lines that connect through telephone switching centers to a variety of destinations. Contrast with *leased lines* and *dedicated lines*.

**switching algebra** Name given to Boolean algebra when it is applied to switching theory.

**switching circuit** Constituent electric circuit of switching or digital systems. Well-known examples of such systems are digital computers, dial telephone systems, and automatic inventory systems.

**switching theory** Theory applied to circuits that have two or more discrete states.

**symbol** (1) Letter, numeral, or mark that represents a number, operation, or relation. (2) Any element of the computer's character set.

**symbolic address** Address, expressed in symbols convenient to the program writer, that must be translated into an *absolute address* (usually by an assembler) before it can be interpreted by a computer. Contrast with *explicit address*.

**symbolic coding** Coding in which the instructions are written in nonmachine language. Coding using symbolic notation for operation codes and operands.

**symbolic device** Name used to indicate an input/output file, such as SYSDSK to specify a

magnetic disk unit. Compare *symbolic I/O assignment*.

**symbolic editor** System program that helps computer users in the preparation and modification of source-language programs by adding, changing, or deleting lines of text.

**symbolic I/O assignment** Name used to indicate an input/output unit, such as RDR used to specify a card reader. Compare *symbolic device*.

**symbolic language** Pseudolanguage made up of letters, characters, and numbers that are not the internal language of the computer system. Also called *fabricated language*. See *assembly language* and *high-level language*.

**symbolic logic** Discipline that treats formal logic by means of a formalized artificial language whose purpose is to avoid the ambiguities and logical inadequacies of natural language.

**symbolic name** See *name*.

**symbolic programming** Using a symbolic language to prepare computer programs.

**symbolic table** Table for comparing a set of symbols to another set of symbols or numbers; for example, in an assembler, the symbol table contains the symbolic label address of an assembled object program.

**symbol string** String consisting solely of symbols.

**symbol table** List of names used in a program with brief descriptions and storage addresses.

**sync character** Character transmitted to establish character synchronization in synchronous communications.

**synchronization** Adjustment of the chronological relationships between events, either to cause them to coincide or to maintain a fixed time difference between them.

## synchronization check

**synchronization check** Check that determines whether a particular event or condition occurs at the proper moment.

**synchronous communications** Method of exchanging data at very high speeds between computers. Involves careful timing and special control codes. Contrast with *asynchronous*.

**synchronous computer** Computer in which each operation starts as a result of a signal generated by a clock. Contrast with *asynchronous computer*.

**synchronous network** Computer network in which all the communications channels are synchronized to a common clock.

**synchronous operation** Operation of a system under the control of clocked pulses.

**synchronous transmission** Data transmission in which the bits are transmitted at a fixed rate. Transmitter and receiver both use the same clock signals for synchronization. Contrast with *asynchronous transmission*.

**synonym** Two or more keys that produce the same table address when hashed. See *hashing*.

**syntax** Rules governing the structure of a language and its expressions. All assembly and high-level programming languages possess a formal syntax. See *programming linguistics*.

**syntax error** Breaking of a rule governing the structure of the programming language being used. Typing RIAD A instead of READ A results in the computer failing to understand what is meant. Usually, the computer will respond to such an instruction by displaying an *error message*, such as "syntax error at line 110." May be a nonfatal or a *fatal error*.

**synthesizer** Output device that generates and processes sound automatically. Some synthesizers include microprocessors, which are used as controlling devices. A voice synthesiz-

er produces sounds that closely resemble a person speaking, musical instruments, and so on.

**SYSGEN** Acronym for SYStems GENeration.

**SYSOP** Acronym for SYStem OPerator, the person who operates an *electronic bulletin board*.

**system** Composite of equipment, skills, techniques, and information capable of performing and/or supporting an operational role in attaining specified management objectives. Includes related facilities, equipment, material, services, personnel, and information required for its operation to the degree that it can be considered a self-sufficient unit in its intended operational and/or support environment.

**system analyzer** Portable device that can be used as a troubleshooting unit for field service of complex equipment and systems.

**system board** Main circuit board of a microcomputer. Also called *motherboard* and *back-plane*.

**system chart** Type of flowchart. See *system flowchart*.

**system commands** Special instructions given to the computer when one operates in the conversational time-sharing mode. Direct the computer to execute programs (RUN), list them (LIST), save them (SAVE), and do other similar operations.

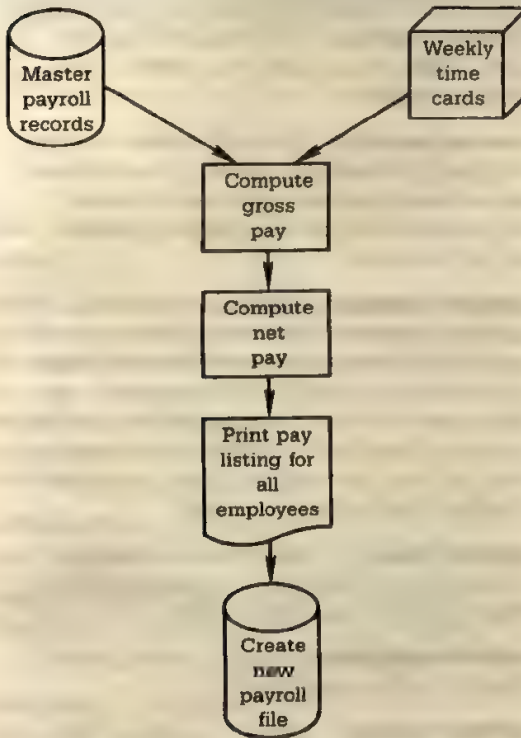
**system diagnostics** Program used to detect overall system malfunctions.

**system disk** Disk that contains the *operating system*.

**system flowchart** Graphic representation of an entire system or portion of a system consisting of one or more computer operations. Composed of interconnected flowcharting symbols arranged in the sequence that the various system operations are performed. Essentially an overall planning, control, and operational



description of a specific application. Contrast with *program flowchart*. See *dataflow diagram* and *flowchart*.



System flowchart

**system follow-up** Continuing evaluation and review of a newly installed system to see that it is performing according to plan.

**system generation (SYSGEN)** Process of initiating a basic system at a specific installation. Involves modifying the generalized operating system received from the vendor into a tailored system meeting the unique needs of the individual user.

**system implementation** Final phase in the creation of a new system. During this phase a system is completely debugged, and it is de-

termined whether it is operational and accepted by the users.

**system installation** Activities by which a new system is placed into operation.

**system interrupt** Break in the normal execution of a program or routine that is accomplished in such a way that the usual sequence can be resumed from that point.

**system loader** Supervisory program used to locate programs in the system library and load them into the internal storage of the computer.

**system maintenance** Activity associated with keeping a computer system constantly in tune with the changing demands placed upon it.

**system priorities** Priorities established to determine the order in which information system projects will be undertaken.

**system programmer** (1) Programmer who plans, generates, maintains, and controls the use of an operating system with the aim of improving the overall productivity of an installation. (2) Programmer who designs programming systems. Contrast with *applications programmer*.

**system reset** Operation that occurs whenever a computer is fooled into thinking that it was turned off and turned on again.

**systems analysis** Examination of an activity, procedure, method, technique, or business to determine what must be accomplished and how the necessary operations may best be accomplished by using data processing equipment. Art or science of analyzing a user's information needs and devising aggregates of machines, people, and procedures to meet those needs.

**systems analyst** One who studies the activities, methods, procedures, and techniques of organizational systems to determine what actions need to be taken and how these actions

## systems design

can best be accomplished. One who does *systems analysis*.

**systems design** Specification of the working relationships between all the parts of a system in terms of their characteristic actions.

**systems engineer** One who performs *systems analysis*, *systems design*, and/or *systems programming* functions.

**systems house** Company that develops hardware and/or software systems to meet user requirements.

**systems manual** Document containing information on the operation of a system. Sufficient detail is provided so management can determine the dataflow, forms used, reports generated, and controls exercised. Job descriptions are generally provided.

**systems programmer** One who understands the interaction between the application software and the systems software on a specific computer system. See *system programmer*.

**systems programming** Development of programs that form operating systems for computers. Such programs include assemblers, compilers, control programs, and input/output handlers. Contrast with *applications programming*.

**systems programs** Programs that control the internal operations of the computer system,

such as *operating systems*, *compilers*, *interpreters*, *assemblers*, graphics support programs, and *mathematical routines*. Contrast with *applications programs*.

**systems resource** Any resource of a computer system that is under the control of the operating system.

**systems security** Technical innovations and managerial procedures applied to the hardware and software (programs and data) to protect the privacy of the records of the organization and its customers

**systems software** Programs that run the computer system and aid the applications programmer in doing his/her task. Typically developed by a vendor and sold to a computer user. The vendor who sells systems software may be the same vendor who sold the user the computer (still the most common case) or may be an independent software vendor.

**systems study** Investigation to determine the feasibility of installing or replacing a business system. See *feasibility study*.

**systems synthesis** Planning of the procedures for solving a problem.

**systems testing** Testing of a series of programs in succession to make sure that all programs, including input and output, are related in the way the systems analyst intended.



# T

**tab** Carriage control that specifies output columns.

**table** Collection of data in a form suitable for ready reference. The data are frequently stored in consecutive storage locations or written in the form of an *array* of rows and columns for easy entry. An intersection of labeled rows and columns serves to locate a specific piece of information.

**table look-up** Procedure for using a known value to locate an unknown value in a table.

**tablet** Input device that converts graphics and pictorial data into binary inputs for use in a computer. See *digitizer* and *graphics tablet*.

**tabulate** (1) To print totals. (2) To form data into a table.

**tag** Portion of an instruction that carries the number of the index register that affects the address in the instruction.

**tail** Special data item that locates the end of a list.

**tailor-made** Refers to a program specially written for one particular task, business, or set of people. Tailor-made programs are usually commissioned by an individual customer and not sold to anyone else.

**talking computer** Computer system that uses a speech *synthesizer* to produce speech.

**tandem computers** Two computers connected together and working on the same problem at the same time.

**Tandy Corporation** Parent company of Radio Shack, a manufacturer of microcomputer systems.

**tangible benefit** Benefit to which a specific dollar amount can be assigned.

**tape** Strip of material that may be punched or coated with a magnetically sensitive substance and used for data input, storage, or output. Data are usually stored serially in several channels across the tape, transversely to the reading or writing motion. See *magnetic tape* and *paper tape*.

**tape cartridge** See *magnetic tape cartridge*.

**tape cassette** Sequential access storage medium used in microcomputer systems for digital recording.

**tape code** See *magnetic tape code* and *paper tape code*.

**tape deck** See *magnetic tape unit*.

**tape drive** See *magnetic tape drive*.

**tape handler** See *magnetic tape unit*.

**tape label** Usually the first record on a magnetic tape reel, containing such information as the date the tape was written, identification name or number, and the number of records on the tape.

**tape librarian** Person responsible for the safe keeping of all computer files, such as programs and data files on magnetic tapes, disk packs, microfilm, and punched cards. Some-

## tape library

times called *custodian*, *data librarian*, or *file librarian*.

**tape library** Special room that houses a file of magnetic tape under secure, environmentally controlled conditions. See *disk library* and *data protection*.

**tape mark** Special code used to indicate the end of a tape file.

**Tape Operating System (TOS)** Operating system in which the programs are stored on magnetic tape.

**tape-to-card converter** Device that converts information directly from paper tape or magnetic tape to punch cards, usually offline.

**tape unit** See *magnetic tape unit*, *paper tape punch*, and *paper tape reader*.

**target disk** Disk to which a program or file is copied. Contrast with *source disk*.

**target language** Language into which some other language is to be properly translated. Usually has the same meaning as *object language*.

**target program** Same as *object program*.

**tariff** In data communications, the published rate for a specific unit of equipment, facility, or type of service provided by a communications common carrier.

**task** Element of work that is part of getting the job done, such as loading of programs into computer storage.

**TB** Abbreviation for *terabyte*.

**technical writer** Person who prepares proposals, training manuals, reference manuals, programming manuals, books, and reports associated with computer equipment and software or other technical fields.

**technology** Knowledge and methods used to create a product.

**technology transfer** Application of existing

technology to a current problem or situation.

**telecommunications** Transfer of data from one place to another over communications lines. See *data communications* and *teleprocessing*.

**telecommunications specialist** Person responsible for the design of data communications networks.

**telecommuting** Working at home with telecommunications between office and home.

**teleconference** Electronic "meeting" conducted among people at distant locations through telecommunications. Considered an alternative to travel and face-to-face meetings, a teleconference is conducted with two-way video, audio, and, as required, data and *facsimile* transmission.

**telecopying** Long-distance copying. Same as *facsimile*.

**telematics** Convergence of telecommunications and automatic information processing.

**telemedicine** Use of telecommunications, particularly television, for transmitting medical data, such as X rays or live images of a patient, to a distantly located specialist for consultation.

**telemetry** Transmission of data from remote measuring instruments by electrical or radio means; for example, data can be telemetered from a spacecraft circling the moon and recorded at a ground station located on Earth.

**Telenet** Communications network that enables many varieties of user terminals and computers to exchange information.

**telephotography** Transmission of photographs over electrical communications channels, generally those provided by common carrier communications companies.

**teleprinter** Automatic printing device.

**teleprocessing** Use of telephone lines to transmit data and commands between remote



locations and a data processing center or between two computer systems. Combined use of *data communications* and data processing equipment. See *telecommunications*.

**telesoftware** Computer programs sent by telephone line or television as part of the tele-text signal.

**teletext** One-way communications medium used in some *videotex* services. Images, each constituting a single frame of TV data in a special, compressed format, are transmitted in a continuous sequence. Users indicate which frame they would like to see by interaction with the decoding unit in their local TV sets. Compare *viewdata*.

**teletypewriter (TTY)** Teletype unit.

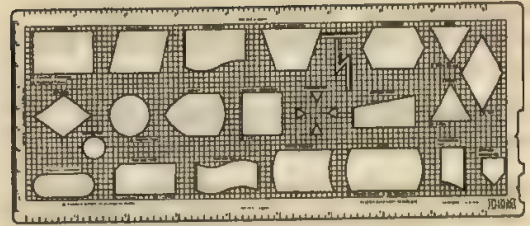
**television receiver (TV)** Display device capable of receiving broadcast video signals (such as commercial television) by means of an antenna. Can be used in combination with a radio-frequency modulator as a display device for several microcomputers. See *video monitor*.

**Telex** Telegraph service provided by Western Union.

**Telpak** Service offered by communications common carriers for the leasing of wideband channels between two or more points.

**template** (1) Plastic guide used in drawing geometric flowcharting symbols. (2) In computer graphics, the pattern of a standard, commonly used component or part that serves as a design aid. Once created, it can be subsequently traced instead of redrawn whenever needed. (3) Set of instructions for relating information within a software development package, usually a spreadsheet, stored on disk. Instructs the computer to perform certain operations on data contained within the spreadsheet; for example, add 10 percent to shipping charges of those customers who live west of the Mississippi River.

**temporary storage** In programming, storage



Template

locations reserved for intermediate results. Synonymous with *working storage*.

**ten-key pad** Separate set of keys numbered 0 through 9 on a keyboard that allow easy entry of numbers. Similar to a calculator *key-pad*.

**ten's complement** Number used to represent the negative of a given value. Obtained by subtracting each digit from a number containing all 9s and adding 1; for example, 654 is the ten's complement of 346 and is obtained by performing the computation  $999 - 346 + 1$ . Synonymous with *true complement*. Compare *one's complement*, *two's complement*, and *nine's complement*.

**tera** Metric prefix for one trillion. Abbreviated T. Contrast with *pico*, one trillionth.

**terabit storage** General term applied to storage devices whose capacity is of the order of  $10^{12}$  bits.

**terabyte** Specifically, 1 009 511 627 776, or  $2^{40}$  bytes. More loosely, one thousand *giga-bytes*, one million *megabytes*, one billion *kilo-bytes*, or one trillion bytes. Used to measure capacities of *optical disk* mass storage devices. Abbreviated TB

**terminal** Keyboard/display or keyboard/printer device used to input programs and data to the computer and to receive output from the computer.

**terminal emulation** Situation in which special software makes a computer behave as though it were a terminal connected to another computer.

## terminal error

**terminal error** Error of sufficient consequence that the program cannot continue. See *fatal error*.

**terminal stand** Wood or metal stand designed to support a computer terminal.

**terminal symbol** Oval *flowcharting symbol* used to indicate the starting point and termination point or points in a procedure.

**ternary** (1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are three possibilities. (2) Pertaining to the numeration system with a *radix* of 3.

**test data** Data especially created to test the operation of a given program. Usually, one or more hand-calculated results, or otherwise known results, will be associated with test data so the program under test may be validated. Also data known to be invalid are used as test data. See *testing*.

**test driver** Program that directs the execution of another program against a collection of *test data* sets.

**testing** Examination of a program's behavior by executing the program on sample data sets, including both valid and invalid data, in an effort to explore all possible causes of misbehavior. See *debug*, *program testing*, *stress testing*, and *systems testing*.

**test plan** General description of what testing will involve, including specification of tolerable limits.

**test run** Run carried out to check that a program is operating correctly. During the run, test data generate results for comparison with previously prepared results.

**text** Words, letters, and numbers that express the information to be conveyed. Contrasted with *graphics*, which are shapes, lines, and symbols.

**text editing** General term that covers any

additions, changes, or deletions made to electronically stored material.

**text editor** Computer program used to manipulate text; for example, to erase, insert, change, and move words or groups of words. The manipulated text may be another computer program.

**text file** File containing information expressed in text form. Same as *data file*.

**text processing** Manipulation of alphabetic data under program control.

**text system** Collection of hardware and specially written software used together to manipulate textual information. See *word processing*.

**texture** In computer graphics, any 2-D pattern used to add the appearance of complexity to a 3-D surface without actually modeling the complexity. Paintings or digitized photographs are frequently used. Whereas *fractals* actually add complexity to a 3-D database, textures do not. The 2-D arrangement of *pixels* in a computed picture is frequently compared to the warp and wool of textiles, hence the term.

**text window** Area on some computer graphics systems display screens within which text is displayed and scrolled.

**theorem proving** Two approaches to automated theorem proving are proof-finding and consequence-finding. A proof-finding program attempts to find a proof for a certain given theorem. A consequence-finding program is given specific axioms for which to deduce consequences. Then "interesting" consequences are selected.

**theory of numbers** Branch of mathematics concerned generally with the properties and relationships of integers.

**thermal printer** *Nonimpact printer* that produces output on heat-sensitive paper. Uses heat to melt wax particles that contain ink, which are then transferred to paper. Has slow speed, mediocre quality reproduction, and uses



expensive paper; the device itself, however, is relatively inexpensive, quiet, and reliable.

**The Source** See *Source (The)*.

**thimble** Printing element (in the form of a thimble) used for letter-quality printing. Character slugs are arranged around the perimeter of the thimble. As the *slug* for the character to be printed spins into the correct position, a hammer drives it forward to print the impression on paper.



Thimble

**thimble printer** Printer that uses a type wheel in the shape of a thimble. The thimble rotates, positioning the spokes so that the striking device can hit the spoke tip against the ribbon, thus printing the character on paper.

**thin film** Computer storage made by placing thin spots of magnetic materials on an insulated base (usually a flat plate or wire); electric current in wires attached to the base is used to magnetize the spot. See *domain tip* and *rod memory*.

**thin window display** One-line display used on keyboards, pocket computers, and so on. Usually an LCD or LED display.

**third generation computers** Computers that use integrated circuitry and miniaturization of components to replace transistors, reduce costs, work faster, and increase reliability. Introduced in 1964 and still the primary technology for digital computers. Compare *first generation computers*, *second generation com-*

*puters*, *fourth generation computers*, and *fifth generation computers*.

**third-party lease** Agreement by which an independent firm buys equipment from the manufacturer and in turn leases it to the end user.

**thirty-two-bit chip** CPU chip that processes data thirty-two bits at a time. See *supermini-computer*. Contrast with *eight-bit chip* and *sixteen-bit chip*.

**Thomas, Charles Xavier (Colmar, Thomas)** Made a calculating machine in 1820 credited with being the first that ever did work practically and usefully.

**thrashing** Overhead associated with memory swapping in a *virtual memory* system. Also called *churning*.

**threaded** Pertaining to a program consisting of calls to several separate subprograms.

**threaded tree** Tree containing additional pointers to assist in the scan of the tree.

**three-address computer** Computer that employs three addresses in its instruction format. For example, in the instruction "ADD A B C," the values represented by A and B are added, and the result is assigned to C. Contrast with *one-address computer* and *two-address computer*. Compare *four-address instruction*.

**three-dimensional (3-D)** In computer graphics, this refers to the three spatial dimensions stored for each point of a model: height, width, and depth.

**three-dimensional array** Array that provides a threefold classification: *row*, *column*, and *layer*.

**throughput** Measure of the total amount of useful processing carried out by a computer system in a given time period.

**thumbwheel** Device for positioning an input cursor; consists of a rotatable wheel that con-

trols the movement of that cursor in one axis. Normally, thumbwheels are found in pairs, one controlling vertical cursor movement; the other, horizontal movement.

**thyatron** See *SCR*.

**thyristor** Bistable device comprising three or more junctions. See *SCR*.

**TICCIT** Acronym for Time-shared, Interactive, Computer-Controlled, Instructional Television, a computer-aided instruction system that uses minicomputers and modified color television sets as terminals to provide individual instruction to many students simultaneously. See *computer-assisted instruction* and *PLATO*.

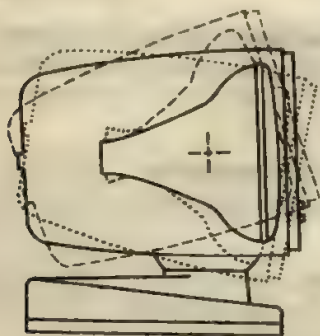
**tie-breaker** Circuitry that resolves the conflict that occurs when two central processing units try to use a peripheral device at the same time. See *contention*.

**tie line** Leased communications channel.

**tie mark** Any marking along a scale to indicate values. Can be used to denote points between identified numerical values.

**tightly coupled** Pertaining to computers that are dependent upon one another.

**tilting screen** Video display screen that can be angled back and forth from top to bottom for easier viewing—one result of *ergonomics*.



Tilting screen

### time-division multiplexing (TDM)

Merging of several bit streams of lower bit rates into a composite signal for transmission over a communication channel of higher bit-rate capacity. See *concentrator*.

**time log** Logging of how the computer system was used during a specified time period, such as 24 hours.

COMPUTER TIME LOG			
Date	Name	Start Time	Stop Time
9/4	Nancy Wilson	0800	0820
9/4	Bill Capicron	0830	0900
9/4	William Smith	0905	1000
9/4	Betty Olson	1030	1034
9/4	Roger Biglan	11:00	11:25

Time log

**time quantum** In a time-sharing system, a unit of time allotted to each user.

**timer** Computer's internal clock.

**time-sharing** Method of operation in which a computer facility is shared by several users for different purposes at (apparently) the same time. Although the computer actually services each user in sequence, the high speed of the computer makes it appear as though the users are all handled simultaneously.

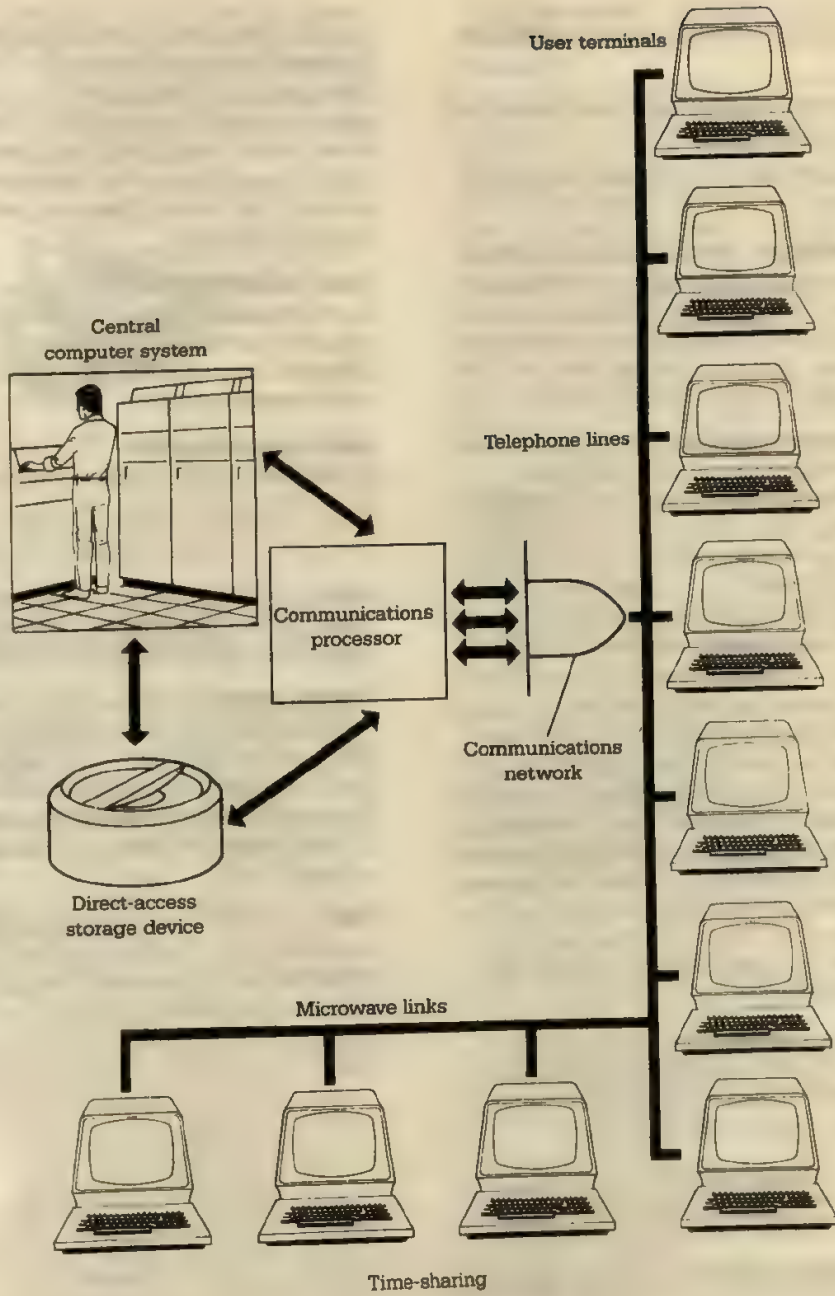
**time slice** Unit of time.

**time slicing** Allotment of a portion of processing time to each program in a *multiprogramming* system to prevent the monopolization of the central processing unit by any one program.

**toggle** Any device having two stable states. Synonymous with *flip-flop*.

**token** (1) Symbol representing a name or entity in a programming language. (2) Group of bits, such as eight 1s, used in some bus net-





tone

works to signal network access by a particular station.

**tone** In computer graphics, the degree of tint and shade in color.

**tool** In some computer systems, an application program.

**toolkit software** Software package that allows users to develop their own special applications more easily than by writing an entire program themselves. Examples are electronic spreadsheets, database management systems, graphic systems, and word processing.

**top-down development** Architectural discipline for computer program development wherein the high-level functions are coded and tested in an outline form early in the development process. Lower-level detail is added and tested progressively. From specifications and interfaces the complete package is constructed beginning with the highest levels of control, such as job control languages and operating system services, progressing to program control modules, and extending to successively more detailed levels of program modules in a hierarchically descending structure. The effect of this approach is twofold. First, the actual system integration effort occurs simultaneously with the development; and second, an increasingly capable operational system is in use during development. See *modular programming* and *structured programming*. Contrast with *bottom-up technique*.

**top-down programming** Programming method that begins with the most general statement of a program and divides it into increasingly detailed sets of routines.

**topology** Physical layout of a computer network. Interconnection of devices and communication channels into a network configuration.

**touch-sensitive panel** See *touch-sensitive tablet*.

**touch-sensitive screen** (1) Display screen

on which the user can enter commands by pressing designated areas with a finger or other object. (2) Specialized type of video display that usually incorporates a clear plastic sheet in front of a video tube. The screen can detect the position where the screen is touched, and the computer can perform the function indicated

**touch-sensitive tablet** Input device that converts graphics and pictorial data into numerical form for use by a computer. Graphic data can be generated by pressing the tablet with a stylus or finger.

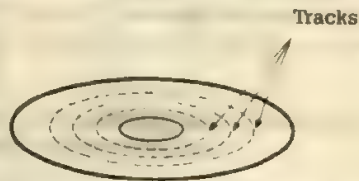
**touch-tone telephone** Push-button telephone used in teleprocessing systems.

**TPI** Acronym for Tracks Per Inch, a measure of storage density in magnetic disks.

**trace** (1) Scanning path of the beam in a raster display. (2) Electrical pathway on circuit boards that connect electronic components.

**tracing routine** Routine that provides a time history of the contents of the computer operational registers during the execution of a program. A complete tracing routine would reveal the status of all registers and locations affected by each instruction each time the instruction is executed.

**track** (1) Path along which data are recorded on a continuous or rotational medium, such as magnetic tape or magnetic disk. (2) To follow or record the moving position of a video display cursor, stylus, mouse, or other input device.

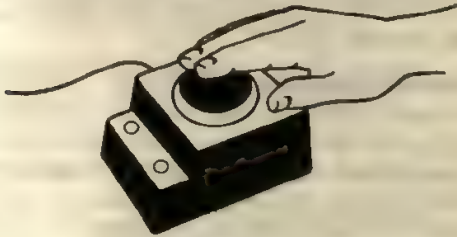


Magnetic disk

Track



**track ball** Device used to move the cursor around on a computer display screen. Consists of a mounting, usually a box, in which is set a ball. As the user spins the ball, the cursor moves at the speed and in the direction of the ball's motion. Compare *mouse*



Track ball

**tracking** Moving a cursor or predefined symbol across the surface of the visual display screen with a light pen, electronic pen, track ball, or mouse.

**tracking symbol** Small symbol on a video display screen that represents the position of the cursor.

**tractor-fed printer** Printer through which paper with holes along its edges is fed by sprocket wheels within the device.

**tractor-feed mechanism** Pair of pin-studded belts that rotate in unison and pull paper, punched with marginal holes, into a printer. See *pin-feed* and *continuous forms*. Contrast with *friction-feed*.

**tradeoff** Balancing of factors in a computer system.

**traffic intensity** Ratio of the insertion rate to the deletion rate of a queue.

**trailer record** Record that follows a group of records and contains data pertinent to the group.

**trailing edge** Edge of a punched card opposite the *leading edge* relative to the direction of motion of the card as it passes along the card track preceding, during, or after reading or punching.

**training manual** Manual designed to be used while learning to use a computer system or program.

**Tramiel, Jack** Founder of Commodore International Ltd.; introduced the Commodore PET microcomputer in early 1977, which became extremely popular in the U.S. and Europe. Later, Tramiel and Commodore developed the VIC-20 and Commodore 64 microcomputers. More recently, Tramiel has guided Atari Corp. in the development of several new microcomputers, including the Atari 520 ST.

**transaction code** One or more characters that form part of a record and signify the type of transaction represented by the record.

**transaction file** File containing relatively transient data to be processed in combination with a *master file*. In a payroll application, a transaction file indicating hours worked might be processed with a master file containing employee name and rate of pay. Also called *detail file*.

**transaction-oriented processing** Activities related to the processing of transactions as they occur. Type of *interactive processing* in which the processing of the data can have a bearing on the transaction—such as hotel, travel, and entertainment reservations, and retail credit sales. See *point-of-sale terminal* and *real-time*.

**transactions** Business or other activities, such as sales, expenditures, shipments, reservations, and inquiries.

**transaction trailing** In database management systems, the creation of an auxiliary file that traces all file updates.

**transborder** Pertaining to data communications between computer systems located across national borders.

**transcribe** To copy from one external storage medium to another. The process may involve *conversion*.

## transducer

**transducer** Any device or element that converts an input signal into an output signal of a different form.

**transfer** (1) To copy or read, transmit, and store an item or block of information. (2) To change control. See *branch*, *conditional transfer*, *jump*, and *unconditional transfer*.

**transfer address** See *entry point*.

**transfer rate** Speed at which accessed data can be moved from one device to another. See *access time* and *seek time*.

**transform** To change the form of data without changing its meaning. See *convert*.

**transformation** In computer graphics, one of the modifications that can be made to the placement or size of an on-screen image. The three basic transformations are *translation*, *scaling*, and *rotation*.

**transformer** AC device used in computer power supplies to reduce 115 volts 60 Hertz to a lower, more suitable voltage usable by computer equipment.

**transient** (1) Pertaining to a phenomenon caused in a system by a sudden change in conditions that persists for a relatively short time after the change. (2) Pertaining to a momentary surge on a signal or power line that may produce false signals and cause component failures.

**transient error** Type of error that occurs only once and cannot be made to repeat itself.

**transient program** Program that does not reside in the computer system's main memory. When needed, the computer reads the program from a disk or tape. Contrast with *resident program*.

**transient suppressors** Devices that smooth out minor voltage errors and usually provide constant, stable current flow. Most suppressors usually protect equipment from short-term high-voltage conditions (*spikes*). See *surge protector*.

**transistor** *Semiconductor device* for controlling the flow of current between two terminals, the *emitter* and the *collector*, by means of variations in the current flow between a third terminal, the *base*, and one of the other two. Developed at Bell Laboratories by William Shockley, Walter Brattain, and John Bardeen. See *Shockley, William*.

**transistor-transistor logic (TTL)** Family of integrated circuits characterized by relatively high speed and low power consumption. Logic circuits based on bipolar devices, usually low-power Schottky circuits that are fast but expensive because gold-plated Schottky diodes are required on every TTL bus input.

**translate** To change data from one form of representation to another without significantly affecting the meaning. See *language translation*.

**translation** (1) In computer graphics, the movement of an image to a new position on the screen. Under translation, every point in the image moves in the same direction with the same speed at any given instant. (2) See *language translation*.

**translator** Computer program that performs translations from one language or code to another. See *assembler*, *compiler*, *interpreter*, and *translation*.

**transmission** Sending of data from one location and receiving of data in another location, usually leaving the source data unchanged. See *data transmission*.

**transmission facility** Communications link between remote terminals and computers, such as communication lines, *microwave transmission lines*, *communications satellites*, *lasers*, telephone lines, *fiber optics*, and waveguides.

**transmit** To send data from one location and to receive the data at another location.

**transparent** Pertaining to any process that is not visible to the user or to other devices. Transparent memory refresh is an example. It



describes a computer operation that does not require user intervention and so is transparent to the user.

**transponder** Amplifier located on a satellite that receives signals from an Earth station and reflects them to a receiving station.

**transportable computer** Small, portable computer, usually weighing less than 20 pounds.

**transpose** To interchange two items of data.

**transversal** Execution of each statement of a program for debugging purposes.

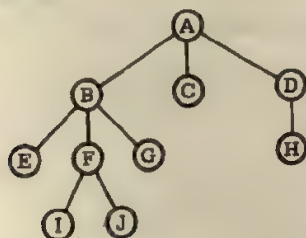
**trap** Programmed conditional jump to a known location, automatically executed when program execution reaches the location where the trap is set. See *interrupt*.

**trapdoor** Breach created intentionally in an information processing system for the purpose of later collecting, altering, or destroying information.

**trapping** Hardware provision for interrupting the normal flow of control of a program while transfer to a known location is made. See *interrupt*.

**tree** Connected graph with no cycles. Also called *tree diagram*. See *forest*.

**tree diagram** Pictorial representation of the logical structure of a program or system. See *leaf*, *node*, and *root*.



Tree diagram

**tree network** Network in which a hierarchy of nodes provides control and communication.

Can be represented on paper as the inverse of a family tree. The apex of the network, or top of the tree, represents the primary control for the network, but certain levels of control may be delegated down to intermediate branches. See *network topologies*.

**tree sort** Sort that exchanges items treated as nodes of a tree. When an item reaches the root node, it is exchanged with the lowest leaf node. Also called heap sort.

**tree structure** Another term for *hierarchical structure*, a form of database organization.

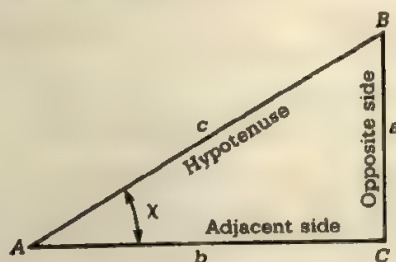
**trend line** Calculated extension of a data series for the purpose of predicting trends beyond known data.

**triad** Any group of three, such as three bits, bytes, or characters.

**trichromatic** Three-colored. In computer graphics, trichromatic generally refers to the three primary colors (red, green, and blue) combined to create all others.

**trigger** Button on a joystick, used in video games to initiate an event, such as firing a missile or leapfrogging a hazard.

**trigonometry** Branch of mathematics dealing with the relations of the sides and angles of triangles, including the various algebraic functions of these relations. In a right triangle, the basic relationships are called trigonometric functions. Trigonometric functions are represented as *library routines* in many programming languages.



Trigonometry

## triple precision

**triple precision** Retention of three times as many digits of a quantity as the computer normally uses. See *precision*. Contrast with *single precision* and *double precision*.

**tristate logic** Form of transistor-transistor logic in which output stages or input and output stages can assume three states. Two are normal low-impedance 1 and 0 states; the third is a high-impedance state that allows many tristate devices to time-share bus lines.

**tristimulus values** Relative amounts of three primary colors combined to create other colors.

**Trojan horse** Pertaining to a crime in which a computer criminal places instructions in someone else's program that will allow the program to function normally but also to perform illegitimate functions.

**tron** Popular high-tech suffix, such as in datatron and cyclotron.

**troubleshoot** To try to find a malfunction in a hardware unit or a mistake in a computer program. Synonymous with *debug*. See *bug*, *debugging aids*, and *test data*.

**TRSDOS** Acronym for Tandy-Radio Shack Disk Operating System, the *operating system* for Radio Shack TRS-80 microcomputers.

**TRS-80 microcomputer** Tradename of several microcomputer systems manufactured by Radio Shack, a division of the Tandy Corporation. See *home computer*, *microcomputer*, *personal computer*, and *Roach, John*.

**True BASIC** Structured version of the BASIC programming language.

**true complement** Synonymous with *ten's complement* and *two's complement*.

**truncate** (1) To reject the final digits in a number, thus lessening precision; for example, 3.14159 truncates the series for  $\pi$ , which could conceivably be extended indefinitely. (2) To cut off any characters that will not fit into an allot-

ted space, such as a ten-character name field on a printed report, in which Rumpelstiltskin would appear as Rumpelstil.

**truncation error** Error due to truncation. Contrast with *round-off error*.

**trunk** Direct line between two telephone switching centers.

**truth table** Systematic tabulation of all the possible input/output combinations produced by a binary circuit.

**T<sup>2</sup>L** Alternate name for *TTL*.

**TTL** Acronym for *Transistor-Transistor Logic*.

**TTY** Acronym for *TeleTYpewriter*.

**tunnel diode** Electronic device with switching speeds of fractional billionths of seconds. Used in high-speed computer circuitry and memories.

**Turbo Pascal** Popular version of the Pascal programming language, available on most microcomputer systems.

**Turing, Alan M.** (1912–1954) English mathematician and logician who, shortly before his death, completed the design of one of the world's first modern high-speed digital computers. See *Turing machine*.

**Turing machine** Mathematical model of a device that changes its internal state and reads from, writes on, and moves a potentially infinite tape, all in accordance with its present state, thereby constituting a model for computer-like behavior. See *Turing, Alan M.*

**TURING** Programming language developed in 1982 by R. C. Holt and J. R. Cordy at the University of Toronto, whose primary design goal was to eliminate some of the inadequacies of the Pascal programming language. Runs under the UNIX operating system.

**Turing's test** Developed by British mathematician Alan Turing, this is a game to determine whether a computer might be considered to possess intelligence. Participants in the



game include two respondents (a computer and a human) and a human examiner who tries to determine which of the unseen respondents is the human. According to this test, intelligence and the ability to think would be demonstrated by the computer's success in fooling the examiner.

**turnaround form** Output document that serves as an input medium during a subsequent phase of processing.

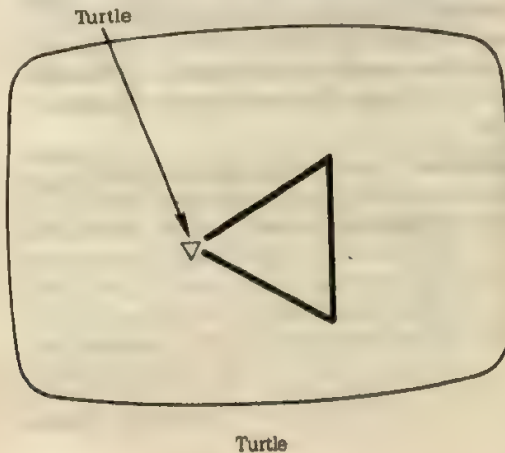
**turnaround time** (1) Time it takes for a job to travel from the user to the computing center, to be run on the computer, and for the program results to be returned to the user. (2) Time spent between transmissions in data transmission using a *half-duplex* channel.

**turnkey system** Prepackaged, ready-to-use computer system containing all the hardware, software, training, and maintenance support needed to perform a given application.

**turn off** Act of turning off (powering down) a computer system.

**turn on** Act of turning on (powering up) a computer system.

**turtle** Small, triangular shape displayed on a screen in the use of *turtle graphics* with the *LOGO* language. Shows the direction of lines



for graphics. For example, if an instruction says "move south," the turtle moves toward the bottom of the screen.

**turtle graphics** Graphics accomplished by a simulated robot that have been incorporated into *LOGO* and other computer languages. Used to teach geometry and computer graphics concepts to children.

**tutorial** Hardware or software training manual. Can be a printed document or recorded in magnetic form on a disk or tape.

**tutorial program** Computer program that explains new material and then tests the user's retention.

**TV** Acronym for TeleVision. See *television receiver*.

**TVT** Acronym for TeleVision Typewriter, a keyboard and electronics specially designed to convert a television into a computer terminal. Video terminal.

**TV terminal** Common television set used as a computer output device. See *video monitor* and *television receiver*.

**tweak** To fine tune or adjust a piece of equipment. To enhance.

**twelve-punch** Punch in the top row of a Hollerith punched card. Synonymous with *Y-punch* and *high-punch*.

**twinkle box** Input device consisting of optical sensors, lenses, and a rotating disk, and capable of determining the three-dimensional position of a light-emitting object by angular light sensing.

**twisted wire** Data communications medium that consists of pairs of wires, twisted together, and bound into a cable.

**two-address computer** Computer that employs two addresses in its instruction format. For example, in the instruction "ADD A B," the values represented by A and B are added, and the result replaces the old value of B.

## two-dimensional (2-D)

Contrast with *one-address computer* and *three-address computer*. Compare *four-address instruction*.

**two-dimensional (2-D)** Describes graphical information presented with visual aspects representing two physical extends: height and width.

**two-dimensional array** Arrangement consisting of rows and columns. See *matrix*. Contrast with *one-dimensional array*

34	49	22	11	36	39	24	1
21	10	85	50	23	12	37	40
48	33	62	57	38	25	2	13
9	20	51	54	63	60	41	26
32	47	58	61	56	53	14	3
19	8	55	52	59	64	27	42
16	31	6	17	44	29	4	15
7	18	45	30	5	16	43	28

Two-dimensional array

**two-pass** Pertaining to an operation or program that has to manipulate its data twice. It partially accomplishes its purpose on the first pass through the data. The operation is completed in the second pass through the data.

**two's complement** Method of representing negative numbers. A positive or negative binary number is changed to the opposite sign by changing all 1s to 0s and all 0s to 1s, then binarily adding 1. Synonymous with *true complement*. Compare *one's complement*, *nine's complement*, and *ten's complement*.

**type ahead** In word processing, a feature

that prevents the loss of characters when the operator is typing faster than the computer can display characters on the screen.

**typeball** Typewriter striking element that contains all the usable characters. Looks like a golf ball with raised characters set around the surface. Mounted on a movable axis, it acts as a hammer, striking the ribbon against the paper to produce the character image.



Typeball

**typeface** Collection of letters, numbers, and symbols that share a distinctive appearance.

**type font** Complete set of characters in a consistent and unique typeface.

**typematic** Any keyboard character that repeats for as long as it is pressed.

**typeover** Ability of an impact printer to strike a character more than once to produce a boldface effect on the printed copy. See *overstriking* and *shadow printing*.

**typesize** Size of type, and type fonts, measured in points. A point is about  $\frac{1}{72}$  of an inch. Points give an approximate measure of the vertical size of type. This book is set in  $9\frac{1}{2}$ -point type.

**typewriter** Input/output device capable of being connected to a computer and used for communications purposes.



# U

**UART** Acronym for *Universal Asynchronous Receiver/Transmitter*.

**UCSD Pascal** Popular version of the Pascal programming language, developed at the University of California at San Diego.

**UCSD p-system** Program development system created by Kenneth Bowles at the University of California at San Diego (UCSD). Includes an operating system, a text editor, and compilers for FORTRAN, Microsoft BASIC, and Pascal. The p refers to "pseudocomputer." The system compilers produce a very compact p-code, which runs on a pseudocomputer. An interpreter converts the p-code into acceptable code for the actual computer on which the program is run, making the system very portable. Only a very small interpreter need be written for each computer on which the p-system runs.

**ULSI** Acronym for *Ultra Large Scale Integration*. Same as *super large scale integration*.

**ultrafiche** *Microfiche* holding images reduced a hundredfold or more.

**ultrasonic** Above the human audio range; that is, above 20 kilohertz.

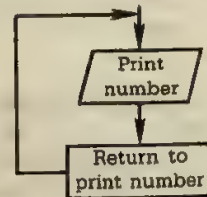
**ultraviolet light** Light with rays shorter than those of visible light but longer than X rays. Used to erase data or instructions stored in an Erasable PROM. Once the EPROM has been erased, it can be reprogrammed by using a PROM programmer.

**unary** See *monadic*.

**unattended operation** Data transmission and/or reception without an operator.

**unbundled** Pertaining to services, programs, training, and so on sold independently of computer hardware by the hardware manufacturer. Contrast with *bundled*.

**unconditional transfer** In program control, an instruction that always causes a branch away from the normal sequence of executing instructions. Contrast with *conditional transfer*.



Unconditional transfer

**uncontrolled loop** Program loop that does not reach a logical end.

**underflow** (1) Condition that arises when a computer computation yields a result smaller than the smallest possible quantity the computer is capable of storing. (2) Condition in which the exponent plus the excess become negative in a floating-point arithmetic operation.

**underpunch** In a punched-card column, a second hole immediately under the original standard code hole punched in the column.

**undo** Word processing command that undoes the effect of previous commands and puts the text back the way it was.

**unibus** High-speed data communications bus structure shared by the CPU, internal memory, and peripherals.

**uninterruptable power supply** Battery-operated device that supplies a computer with electricity in the event of a brownout or black-out.

**unipolar** Having one pole. Contrast with *bipolar*.

**unit** Any device having a special function, such as the arithmetic-logic unit, central processing unit, or magnetic tape unit.

**unit position** Extreme right position of a field, especially an integer numeric field.

**unit record system** Data processing system that uses electromechanical processing machines, such as sorters and collators, operated by technicians, as contrasted with a more automated computerized system. Most unit record installations have been replaced with modern computer equipment.

**UNIVAC I** First commercial electronic digital computer. Completed in 1951, it was used by the Census Bureau for processing some of the data from the 1950 census. Forty-eight of these computers were built. See *Mauchly, John*.

**universal asynchronous receiver/transmitter** Integrated circuit device that receives serial data and converts it into parallel form for transmission, and vice versa.

**universal identifier** Standard multidigit number assigned to an individual to be used in verifying her or his identity.

**universal language** Any programming language available on many computers, such as FORTRAN, COBOL, and BASIC. Same as *common language*.

**Universal Product Code (UPC)** Ten-digit computer-readable code developed by the supermarket industry for identifying products and manufacturers on product tags. A variety of

manufacturers produce printers to print the 10-digit bar symbols and optical scanning devices to read the codes during supermarket check-out. Code includes a 5-digit manufacturer identification number and 5-digit product code number.

**UNIX** *Operating system* designed by AT & T Bell Laboratories. Originally intended for use on minicomputers; later adapted for microcomputers.

**unpack** To separate short units of data that have previously been packed. Opposite of *pack*.

**unpopulated board** Circuit board whose components must be supplied by the purchaser. Contrast with *populated board*.

**unset** To change the value of a bit (or a group of bits) to binary 0.

**up** State of a computer system that is currently operating.

**up-and-running** Used to indicate that a computer system or a peripheral device has just been put into operation and is working properly.

**UPC** Acronym for Universal Product Code.

**update** To make data files more current by adding, changing, or deleting data. See *file maintenance*.

**upgrade** To reconfigure a computer system to increase its computing power.

**upload** To transfer data from a user's system to a remote computer system. Opposite of *download*.

**upper case** Capital letters. All VDTs have the capability of using these. Contrast with *lower case*.

**uptime** Period of time that equipment is working without failure. Contrast with *available time* and *downtime*.

**upward compatible** Term used to indicate



that a computer system or peripheral device can do everything that the previous model could do, plus some additional functions. See *compatibility*.

**usability** Worth of a system as evaluated by the person who must use it.

**user** (1) Anyone who owns or utilizes a computer for problem solving or data manipulation. (2) Anyone who requires the services of a computer system. Also called *end user*.

**user-defined function** Any function that has been defined by the user.

**user-defined key** Computer keyboard key that has a predefined function or whose function can be changed by a program. The function is performed by the computer whenever the key is depressed.

**user-friendly** Term applied to software and/or hardware that has been designed to be easily used, without the user having to remember complex procedures. Very easy for the inexperienced person to use.

**user group** Group of computer users who share the knowledge they have gained and the programs they have developed on a computer or class of computers of a specific manufacturer. Usually meet to exchange information, share programs, and trade equipment. Provide a valuable opportunity to get and give advice on computer hardware, software, and applications. Often a member can talk to someone who used a product he or she is considering

buying or using. Newsletters also offer useful information.

**user-oriented language** See *problem-oriented language* and *procedure-oriented language*.

**user profile** Information used as a part of a security system, such as the user's job function, areas of knowledge, access privileges, and supervisor.

**user's manual** Document describing how to use a hardware device, a software product, or a system.

**user terminal** See *terminal*.

**utility** Program that helps the user run, enhance, create, or analyze other programs, programming languages, operating systems, and equipment.

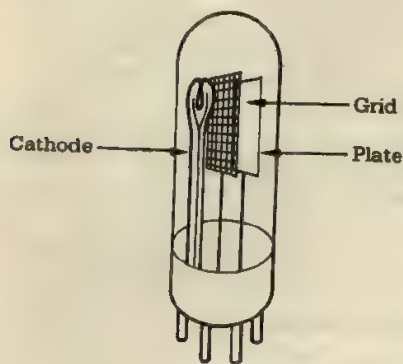
**utility programs** Computer programs that provide commonly needed services, such as transferring data from one medium to another (disk to tape) and character conversion. Vendors of large computer systems commonly supply a set of utilities with their systems. Utilities are designed to facilitate or aid the operation and use of the computer for a number of different applications and uses. Examples of utilities are memory-dump programs, program debugging aids, file-handling programs, mathematical routines, sorting programs, and text editors.

**utilization statistics** Measure of a computer's performance based on the time log.

# V

**VAB** Acronym for Voice Answer Back, an audio response device that can link a computer system to a telephone network, thus providing voice response to inquiries made from telephone-tape terminals.

**vacuum tube** Device for controlling flow of electrical current. Dominant electronic element found in computers prior to the advent of the transistor. Those computers using vacuum tubes are referred to as *first generation computers*.



Vacuum tube

**VAL** Acronym for Vicarm Arm Language, a computer language for controlling robots. See *robot control languages*.

**validation** Examination of data for correctness against certain criteria, such as format (patterns of numbers, spaces, and letters), ranges (upper and lower value limits), check digits, and equivalent entries on a master file.

**value** Any constant or quantity stored in a computer's memory.

**value-added network** System in which a carrier leases communication lines from a common carrier, enhances them by adding improvements, such as error detection and faster response time, and then leases them to a third party.

**variable** Quantity that can assume any of a given set of values. For example, in a BASIC program that states PRINT A, B, C, the variables A, B, and C represent the actual values that will be printed. See *subscripted variable*. Contrast with *constant*.

**variable-length record** Record in a file in which records are not uniform in length. Contrast with *fixed-length record*.

**variable name** Alphanumeric term that identifies a data value in a program. The term can assume any of a set of values.

**variable word length** Pertaining to a machine word or operand that may consist of a variable number of bits, bytes, or characters. Contrast with *fixed word length*.

**VAX** Designation for large minicomputer systems manufactured by Digital Equipment Corporation.

**VDL** Acronym for Vienna Definition Language, a language for defining the syntax and semantics of programming languages.

**VDT** Acronym for *Video Display Terminal*, an



input/output device consisting of a display screen and an input keyboard. Synonymous with CRT terminal.

**VDU** Acronym for Visual Display Unit, a peripheral device on which data are displayed on some type of screen.

**vector** (1) List of numbers, all of which are expressed on the same line, such as a single column or row. (2) Quantity having magnitude and direction, as opposed to *scalar value*. (3) In computer science, a *data structure* that permits the location of any item by the use of a single index or *subscript*. (4) Type of cathode ray tube on which graphic data are represented by lines drawn from point to point rather than by illumination of a series of contiguous positions, as on a *raster display* device. (5) In plotting, an element of a line connecting two points.

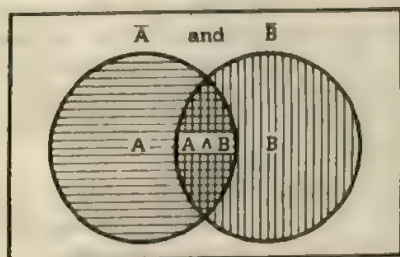
**vector display** Cathode ray tube that moves the electron beam randomly to trace figures on the screen. Contrast with *raster display*.

**vector pair** Data points that make up the opposite ends of a vector.

**vendee** Person or business that purchases a hardware or software system.

**vendor** (1) Company or business entity that sells computers, peripheral devices, time-sharing service, or computer services. (2) Any supplier from whom a vendee may purchase material.

**Venn diagram** Diagram that uses circles



Venn diagram

and ellipses to give a graphic representation of logic relationships.

**verifier** Device used to detect keypunching mistakes by rekeying. See *card verification* and *key-verify*.

**verify** (1) To determine whether a data processing operation has been accomplished accurately; for example, to check the results of keypunching. (2) To check data validity.

**version** Specific release of a software product of a specific hardware model. Usually numbered in ascending order. For example, DOS 3.3 is a later version of a disk operating system than is DOS 3.1 or DOS 1.0.

**vertex** (1) Point where two sides of an angle meet. (2) Highest or lowest point on a graphed line.

**vertical recording** Technology that strives to stand magnetic bits of information on end instead of side by side on a disk as they are today. Using this technology, several billion bytes of information could be stored on one disk.

**vertical scrolling** Ability of a system to move up and down through a page or more of data displayed on the video screen. See *scrolling*.

**very large scale integration (VLSI)** Process of placing a large number (usually between 1000 and 1 million) of components on one chip. See *fourth generation computer*. Compare *small scale integration*, *medium scale integration*, *large scale integration*, and *super large scale integration*.

**vetting** Process of making a background investigation of a person to reduce security risks.

**VHSIC program** Very High Speed Integrated Circuit program, a joint government/private-industry effort, the purpose of which is to provide the Department of Defense with advanced

## video

integrated circuits for use in future weapons and armaments

**video** Visual display, especially on a *video display terminal*.

**video digitizer** Input device that converts the signal from a video camera into digital form and stores it in computer storage, where it can be analyzed or modified by the computer. See *digitizer*.

**videodisk** Plastic platter resembling a phonograph record that uses low-intensity laser beams to store visual materials that will appear on a display screen. Many videodisk units can be controlled by a computer

**video display terminal (VDT)** Device for entering information into a computer system and displaying it on a screen. A typewriterlike keyboard is used to enter information. See *cathode ray tube*, *display*, and *screen*.

**video game** Interactive game of skill and strategy in which the player operates a picking device, such as a joystick or paddle, while observing the graphics of the action on the display screen. Popular activity on personal computers and in amusement arcades.

**video game machine** Microprocessor-controlled machine designed principally for running commercially produced cartridges and disks that contain games and educational programs.

**video generator** Device that generates the signals that control a television display.

**video input camera** Video camera that converts images (photographs, real-life situations, drawings) into dot-by-dot images in a computer's memory. The digitized images may be shown on a display screen or printed on paper by a graphics printer.

**video monitor** Device functionally identical to a television set, except that it has no channel selector. Receives its picture signal from an

external source, such as a video terminal board. See *television receiver*.

**video signal** Electronic signal containing information specifying the location and brightness of each point on a CRT screen, along with timing signals to place the image properly on the screen.

**videotex** Generic term for electronic home information delivery systems. Within this broad term, there are two specific approaches, called *viewdata* and *teletext*.

**videotext** Interactive electronic information system. Similar to *teletext* except that the user can transmit information to the system. Also called *viewdata*.

**vidicon** Tube inside a TV camera that converts the image of a scene into an electrical signal.

**view** Way of presenting the contents of a database to the user, not necessarily the same as the way the fields and records are stored in the database. Different users or programs that call upon the database for information may have unique views of the data.

**viewdata** Home information delivery system through which users can access a central database interactively from their local TVs. Users may request specific frames of information. More importantly, they can directly access what they want, meaning quicker response time and a more structured usage of the medium. Users can communicate with other users via the system (*electronic mail*). They can also utilize transactional services, including shopping or banking, based on information provided by the system. Also called *videotext*. Compare *teletext*.

**viewport** Process that allows a user to place any selected picture in a chosen location on a video display screen. Compare *window*.

**virtual** Appearing to be rather than actually being, as in *virtual storage*.



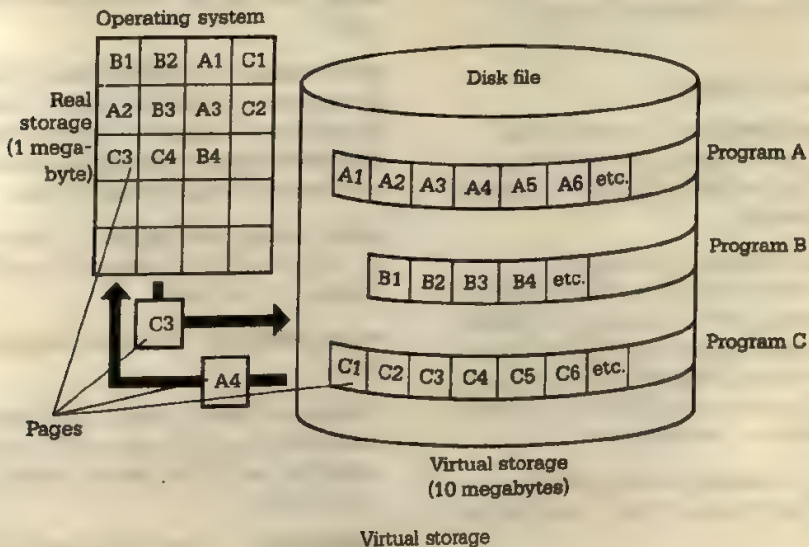
**virtual address** In *virtual storage* systems, an address that refers to virtual storage and must, therefore, be translated into a *real storage* address when it is used.

**virtual machine** Illusion of having many copies of the existing computer running simultaneously.

**virtual memory** See *virtual storage*.

**virtual storage (VS)** Technique for managing a limited amount of *internal storage* and a (generally) much larger amount of lower-speed storage in such a way that the distinction is largely *transparent* to a computer user. The technique entails some means of swapping segments of the program and data from the lower-speed storage (which would commonly be a drum or disk) into the internal storage, where it would be interpreted as instructions or operated upon as data. The unit of program or data swapped back and forth is called a *page*. The high-speed storage from which instructions are executed is called *real storage*; the lower-speed storage (drums or disks) is called *virtual storage*.

### Virtual Storage Operating System (VSOS)



Operating system that uses a computer system's virtual storage capability

**VisiCalc** Popular *electronic spreadsheet* program. Name derived from Visible Calculation. Displays information on a screen as an electronic sheet or grid. Locations within the grid are treated as variables. To manipulate a variable, the user applies an operation to the variable's location in the grid. (See page 308.)

**vision recognition** Method for processing pictorial information by computer. For example an *artificial intelligence* computer can recognize a TV image of a horse and say (or print out), "It is a horse." Recognizing images is a very complex process for machines. See *image processing*.

**visual display** Visual representation of data, such as a picture or diagram drawn on a display screen or a diagram produced by a plotter.

**visual page** Visual representation consisting of one or more stored screen display files.

**visual scanner** See *optical character reader*.

**VLDB** Acronym for Very Large Data Base, a database distributed among multiple computers with different database management systems.

## Monthly Rental Record

Period 1980 To :B1 Rental Name: Greenacre Plaza							
Rental Address: 2251 Whitfence Rd.							
Month	Unit No.						Month
Rented	1	2	11	12	13	20	Totals
JANUARY	300.00	275.00	450.00	325.00	150.00	210.00	1710.00
FEBRUARY	300.00	275.00	450.00	325.00	150.00	210.00	1710.00
MARCH	325.00		467.50	350.00	175.00	230.00	1547.00
APRIL	325.00		467.50	350.00	175.00	230.00	1547.00
MAY	325.00		467.50	350.00	175.00	230.00	1547.00
JUNE	325.00		467.50	350.00	175.00	230.00	1547.00
JULY	350.00		475.00	375.00	185.00	250.00	1845.00
AUGUST	350.00		475.00	375.00	185.00	250.00	1845.00
SEPTEMBER							0.00
OCTOBER							0.00
NOVEMBER							0.00
DECEMBER							0.00
Unit	Cross Check Total=						12900.00
Totals	2600.00	550.00	3720.00	2800.00	1390.00	1840.00	12900.00

## VisiCalc

**VLSI** Acronym for *Very Large Scale Integration*.

**vocabulary** Codes or instructions that can be used to write a program for a particular computer.

**voder** *Speech synthesizer*.

**voice communications** Transmission of sound in the human hearing range. Voice or audio sound can be transmitted either as analog or digital signals.

**voice grade** Pertaining to computer-to-computer links that employ the lines used in normal telephone communications. Essential to most telecommunications, these lines permit data transmission at frequencies from 300 to 3000 Hz and at rates up to 9600 baud. Contrast with *broadband* and *narrowband*.

**voice input** Input device that permits a human voice to be used as input to a computer.

**voice mail** Messages spoken into a telephone, converted into digital form, and stored in the computer's memory until recalled, at which time they are reconverted into voice form.

**voice output** Audio response device that permits the computer to deliver output by the spoken word. Range of uses includes *computer-assisted instruction* and *self-service gas stations*. See *phonetic system*.

**voice recognition system** System designed to recognize and understand the voice and vocabulary of the user.

**voice response** Computer output in spoken form.

**voice synthesis** Ability of a computer to use stored patterns of sounds within its memory to assemble words that can be played through a loudspeaker.

**volatile file** Any file in which insertion of



new records or deletion of old records occurs at a high rate. Access time is critical.

**volatile storage** Storage medium whose contents are lost if power is removed from the system. See *dynamic RAM*. Contrast with *non-volatile storage*.

**volatility** When a file is processed, percentage of records added or deleted. Important parameter in designing a database.

**voltage** Electrical pressure. High voltage in a computer circuit is represented by 1; low (or zero) voltage is represented by 0.

**voltage regulator** Circuit that holds an output voltage at a predetermined value or causes it to vary according to a predetermined plan, regardless of normal input-voltage change or changes in the load *impedance*.

**voltage surge protector** See *surge protector*.

**volume** Physical unit of a storage medium, such as a disk pack, diskette, or tape reel,

capable of having data recorded on it and subsequently read.

**von Neumann, John** (1903–1957) One of the outstanding mathematicians of this century. He built one of the first electronic computers, contributed much to game theory, and introduced the *stored-program concept*.

**von Neumann machine** The machine defined by John von Neumann in 1945 in a report titled "Preliminary Discussion of the Logical Design of an Electronic Computing Instrument." Central to the von Neumann machine is the concept of the stored program—the principle that instructions and data are to be stored together, intermixed in a single, uniform storage medium. See *stored-program concept* and *von Neumann, John*.

**VRC** Acronym for Vertical Redundancy Check.

**VS** Acronym for *virtual storage*.

**vulnerability** Weaknesses in a computer system that pose security hazards.

# W

**wafer** Three- or four-inch, thin, circular disk on which many integrated circuits are fabricated and subsequently diced up into individual chips. See *silicon wafer*.

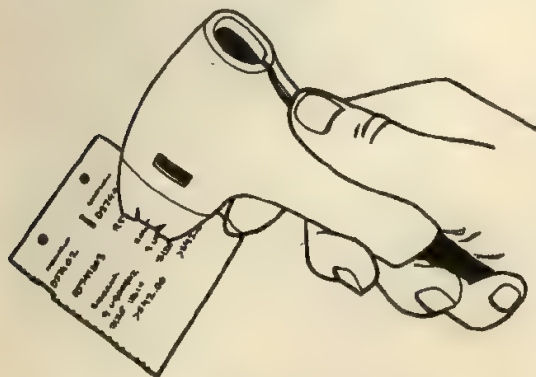
**wait state** Condition in which the central processing unit is idle, not executing instructions.

**wait time** Time during which a program or a computer waits for the completion of other activities.

**walkthrough** See *structured walkthrough*.

**WAMI** Acronym for World Association for Medical Informatics.

**wand** Hand-held optical device that can read and identify coded labels, bar codes, and characters.



Wand

**warm boot** Process of fooling the computer into thinking that its power has been turned

off although power is still on. Contrast with *cold boot*.

**warm start** Same as *warm boot*.

**warm-up time** Interval between the energizing of a device and the beginning of the application of its output characteristics.

**warning message** Diagnostic message produced by a compiler to alert the user to a nonfatal error

**WATFIV** See *WATFOR*.

**WATFOR** Version of *FORTTRAN* developed at the University of Waterloo in Ontario, Canada. WATFIV is a revision of WATFOR.

**WATS** Acronym for *Wide Area Telephone Service*.

**Watson, Thomas J., Sr.** (1874–1956) Guiding spirit of IBM Corporation, a superb salesman and president of IBM until 1952. Although his motto was THINK, he did not think there would be much demand for digital computers.

**Watson, Thomas J., Jr.** Guided IBM Corporation into its leadership position in the computer industry.

**WCCE** Acronym for *World Conference on Computers in Education*.

**weed** To discard currently undesirable or needless items from a file.

**weighted code** Code in which each bit position has a weighted value. In the 8-4-2-1



weighted-code system, the decimal numeral 529 would be 0101 0010 1001.

**West Coast Computer Fair** Major micro-computer trade show held annually in San Francisco.

**wetzel** Picture element added to the image on a cathode ray tube to improve the sharpness of the display. Compare *pixel*.

**What if?** Premise on which most electronic *spreadsheet* programs operate. New values may be substituted to determine the resultant effect on other values.

**wheel printer** Printer with a printing mechanism that contains the printing characters on metal wheels. Type of *line printer*.

**white noise** Continuous noise produced over all audible frequencies to "fill in the gaps" between discontinuous office distractions such as printers, keyboards, and footsteps. Compare *pink noise*.

**whole number** Positive number without a fractional part, such as 84 or 22.0, or 0 (the only nonpositive whole number). Positive *integer* or zero.

**wide-area network** Data communication network designed to serve an area of hundreds of thousands of miles.

### **Wide Area Telephone Service (WATS)**

Service provided by telephone companies that permits a customer, by use of an access line called a WATS line, to make data communications in a specific zone on a dial basis for a flat monthly charge. The U.S. is divided into six WATS zones.

**wideband** In data communications, a channel wider in bandwidth than a voice-grade channel. Same as *broadband*. Compare *narrowband*.

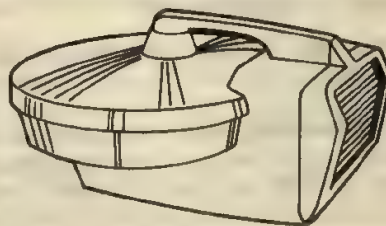
**widow** Last line of a paragraph sitting alone at the top of a page of text. Considered undesirable in all forms of printing. Compare with *orphan*.

**Wiener, Norbert** (1894–1964) American scientist who coined the term *cybernetics*, a new branch of science. Believed that many thought processes in the human brain could be determined mathematically and adapted for computers. Pioneer in the theory of *automata*. See *artificial intelligence*.

**wild card** Method of file-naming conventions that permits an operating system to perform utility functions on multiple files with related names, without the programmer or user having to specify each file by its full, unique name. For example, if a word processor is directed to search for "Don," it might locate "Donald" as well as "Donna" if both were present in the file. See *global character*.

**Wilkes, Maurice Vincent** Headed the team of people at the University of Cambridge (Great Britain) who built the Electronic Delay Storage Automatic Calculator (EDSAC) in 1949.

**Winchester disk drive** Fast auxiliary storage device. Type of hard disk sealed in an air-tight, dust-free container.



Winchester disk drive

**window** Portion of the video display area dedicated to some specific purpose. Special software allows the screen to be divided into multiple windows that can be moved around and made bigger or smaller. Windows allow the user to treat the computer display screen like a desktop where various files can remain open simultaneously. Compare with *viewport*.

**windowing** Act of displaying two or more files or disparate portions of the same file on the screen simultaneously.

wire board

**wire board** See *control panel*.

**wired-program computer** Computer in which the instructions that specify the operations to be performed are specified by the placement and interconnection of wires. The wires are usually held by a removable control panel, allowing limited flexibility of operation. Also applied to permanently wired machines that are then called *fixed-program computers*.

**wire wrap** Type of circuit board construction. Electrical connections are made through wires connected to the posts that correspond to the proper component leads.

**Wirth, Niklaus** In 1968, in Switzerland, he developed the computer language *Pascal* (named for Blaise Pascal), a popular high-level programming language that facilitates the use of structured programming techniques.

**wizard** Experienced *hacker*.

**word** Logical unit of information. Group of bits, characters, or bytes considered as an entity and capable of being stored in one storage location. Compare *keyword*.

**word length** Number of bits in a word, usually 4, 8, 16, or 32.

**word processing (WP)** Technique for electronically storing, editing, and manipulating text by using an electronic keyboard, computer, and printer. The text is recorded on a magnetic medium, usually floppy disks. The final output is on paper.

**word processing center** Central facility that contains the word processing equipment and personnel that prepare written communications for an organization.

**word processing operator** Individual who operates word processing equipment

**word processing program** Software that guides the computer system in writing, editing, and formatting text. Same as *word processor*.

**Word Processing Society (WPS)** Organization that encourages word processing educational programs in schools to promote word processing as a profession.

**word processing system** Information processing system that relies on automated and computerized typing, copying, filing, dictation, and document retrieval. Increasingly used in modern offices.

**word processor** Computer program that provides for manipulation of text. Can be used for writing documents; inserting or changing words, paragraphs, or pages; and printing documents.

**Wordstar** Popular *word processor* available on most microcomputer systems.

**word wrap** Feature that automatically moves a word to the beginning of the next line if it will not fit at the end of the original line. Feature found in word processing systems.

**workbench** Programming environment in which hardware and software items are shared by several users.

**work breakdown structure** Comprehensive listing of the work elements and dependencies required to complete a given project; a tool for the project planner, serving as a predefinition to speed up the planning process.

**working storage** Same as *temporary storage*.

**worksheet** Same as *spreadsheet* and *plan-sheet*.

**workspace** Loosely defined term that usually refers to the amount of internal storage available for programs and data and allocated for working storage.

**workstation** Configuration of computer equipment designed for use by one person at a time. This may have a terminal connected to a computer, or it may be a stand-alone system with local processing capability. Examples of workstations are a stand-alone graphics sys-



tem, a word processor, and a time-sharing terminal.

**work year** Effort expended by one person for one year. Term used to estimate the personnel resources needed to complete a specific task.

**World Conference on Computers in Education (WCCE)** International computer education conference sponsored by the *International Federation for Information Processing* and the *American Federation of Information Processing Societies*. Held every four years in a different country. See *National Conference on Computers in Education*.

**Wozniak, Stephen** Co-founder of Apple Computer, Inc., developer of several microcomputer systems, including the Apple IIc, Apple IIe, and Macintosh. See *Jobs, Steve*.



Stephen Wozniak

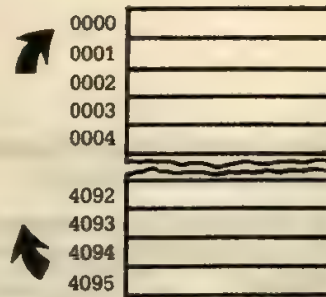
**WP** Acronym for *Word Processing*.

**WPM** Acronym for Words Per Minute, a measure of data transmission speed.

**WPS** Acronym for *Word Processing Society*.

**wraparound** Continuation of an operation,

such as a change in the storage location from the largest addressable location to the first addressable location; or a visual display cursor movement from the last character position to the first position.



Wraparound

**write** (1) Process of transferring information from the computer to an output medium. (2) To copy data, usually from internal storage to auxiliary storage devices. Contrast with *read*.

**write-enable ring** Plastic ring that must be placed on a tape reel before information can be recorded on the tape. Compare *write-protect ring*.

**write head** Magnetic head designed to write data onto the media. Contrast with *read head*. Compare *read/write head*.

**write-inhibit ring** Plastic ring used to prevent data from being written over on magnetic tapes. Same as *write-protect ring*.

**write protect** Procedure for preventing a disk or tape from being written to.

**write-protect notch** Floppy disks (diskettes) may be protected from the possibility of undesired recording of data by application of a gummed tab over the write-protect notch. An uncovered write-protect notch will allow writing to the *diskette*. See *file protection*.

**write-protect ring** Plastic ring that, when removed from the back of a tape reel, prevents writing on the tape. Also called *write-inhibit ring*. See *file-protect*.

# X

**X axis** On a coordinate plane, the horizontal axis. Contrast with *Y axis* and *Z axis*.

**XENIX** Variation on the UNIX operating system, created by Microsoft Corporation for use on microcomputers.

**xerographic printer** Device for printing an optical image on paper in which light and dark areas are represented by electrostatically charged areas on the paper. A powdered ink dusted on the paper adheres to the charged areas and is melted into the paper by heat. See *electrostatic printer* and *nonimpact printer*.

**XOR** Acronym for *eXclusive OR*.

**X-punch** Punch in the eleventh punching position (row 11) of a *Hollerith card*. Synonymous with *eleven-punch*. Compare *Y-punch* and *zone punch*.

**X-Y chart** Form that allows plotting of one data series against another, without a time axis. Often used to determine if there is a correlation between two series, with the direction, slope, and curvature of the line showing the relationship.

**X-Y plotter** Output device that draws points, lines, or curves on a sheet of paper based on X and Y coordinates from a computer. See *plotter*.

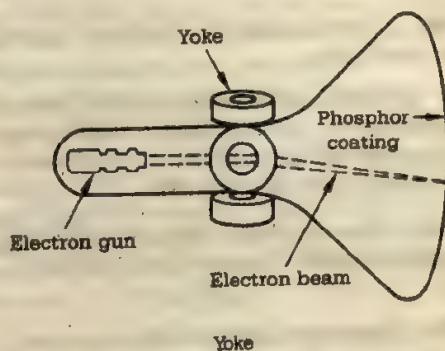


# Y

**Y axis** On a coordinate plane, the vertical axis. Contrast with *X axis* and *Z axis*.

**Y-punch** Punch in the twelfth position (row 12) of a *Hollerith card*. Also called *high-punch* and *twelve-punch*. Compare *X-punch* and *zone punch*.

**yoke** That part of the *electron beam deflection system* used for addressing a video display.



# Z

**zairja** Thinking machine constructed by early Arab astrologers.

**zap** (1) Command in many *electronic spreadsheet* programs that irretrievably erases all information on the spreadsheet. (2) To delete a file or clear a screen accidentally.

**Z axis** On a coordinate plane, the axis that represents depth. Contrast with *X axis* and *Y axis*

**Z-80** Popular 8-bit microprocessor chip used as a base for microcomputers.

**zero** Numeral normally denoting lack of magnitude. In many computers, there are distinct representations for plus and minus zero.

**zero flag** *Flip-flop* that goes to logic 1 if the result of an instruction has the value of zero.

**zeroize** To initialize a program with zeros. To fill spaces in memory with zeros.

**zero suppression** Suppression (elimination) of nonsignificant zeros in a numeral, usually before or during a printing operation. For example, the numeral 00004763, with zero suppression, would be printed as 4763. Commonly used in pagination so early pages of a report will be numbered 1, 2, . . . rather than 01, 02, . . . or 001, 002, . . .

**zone bits** Special bits used along with numeric bits to represent alphanumeric characters in *ASCII* and *EBCDIC* codes.

**zone punch** Punch in the 0, X, or Y row on a *Hollerith card*.

**zooming** Changing of a view on a graphics display by either moving in on successively smaller portions of the currently visible picture or moving out until the window encloses the entire scene. Capability that proportionally enlarges or reduces a figure displayed on a visual display screen. See *image enhancement*.

**Zuse, Konrad** German pioneer in the development of computing equipment. In 1941, he completed the Zuse Z-3, a machine with some remarkably advanced features. The speed of this machine was about the same as the *Mark I*.



Konrad Zuse



# HOW TO BUY A PERSONAL COMPUTER

Whether it's for school or home, work or play, a personal computer can save you time and money, increase your productivity, and process information with speed and accuracy. Because of the revolutionary changes in the industry and the marketplace, however, deciding which machine to buy can be bewildering. What tasks do I want my software to accomplish? Do I want a portable or a full-size machine? Where can I go if my machine breaks down? You must address several issues before you can make an intelligent choice.

## WHAT COMPUTERS CANNOT DO FOR YOU

Before examining what you want a computer to do for you, it's important to understand what it *cannot* do. First, regardless of the brand you buy, a microcomputer cannot do your thinking for you. Computers can only follow specific, logical steps based on the information you enter through the keyboard or insert on software disks. For example, if you buy word processing software with the hope that it will make the human thought processes that go into writing a report less rigorous, you're bound to be disappointed. Word processing programs can make the mechanics of writing much easier; however, they cannot miraculously equip you with the organizational and creative skills needed to produce well-written reports. You provide the inspiration; the computer relieves you of much of the drudgery involved with writing.

A corollary to this situation is that a computer can only feed back information based on the raw data you put in. For example, a financial software package used for making sales forecasts will provide results that are equivalent to the accuracy of the figures you enter. If the entered figures are wrong or out-of-date, the results of the computer's calculations will reflect these inaccuracies. Here again, the computer's value lies in the colossal amounts of time and frustration it saves you from doing manual, calculation tasks.

Another limitation is that the computer does only what it is told, either by the software or by a human operator. In other words, a computer is only as smart as the instructions you give it. If instructions are wrong or incomplete, you can curse and yell at "that dumb machine" as long as you like; the computer will just sit humming placidly on your desk until it receives correct directions.

Finally, no computer system is absolutely "bugfree." Since the machines are designed by humans and humans cannot think of every possible contingency and safeguard, computers may do some things that are unexplainable. With improved technology, however, most of the bugs have been worked out of systems. Considering the complexity of the parts contained inside microcomputers, these machines have amazing performance records.

# HOW TO BUY A PERSONAL COMPUTER

## WHAT COMPUTERS CAN DO FOR YOU

Unless you plan to use your computer solely to create your own programs, software will determine what your computer can do for you. With very few exceptions, software is machine-specific; in most cases, printers and other peripheral devices are also. What runs on an IBM Personal Computer may not run on an Apple IIe or a Commodore 128 microcomputer. So before you even look at hardware, you must decide what tasks you want to accomplish and find the best software for the job. Then, and only then, can you make a wise selection about which computer to buy.

In practical ways, selecting a computer is like buying a car. A family of seven would be foolish to choose a sports car as its only method of transportation. The sports car might be perfect for a single person with a small garage, while a station wagon would probably be the best choice for the large family. Like cars, computers are equipped with the same basic parts, but they serve completely different needs.

The two basic types of software used with computers are

- 1 Systems software, which comes with the hardware and tells the computer how to operate
- 2 Applications software, which equips the computer to perform a specific task such as word processing accounts receivable

Most people who buy personal computers are nonprogrammers interested primarily in applications software that will equip their computers to perform specific tasks. To meet these popular applications software needs, a huge commercial market has blossomed. According to recent figures from FIND/SVP, a New York-based information and research firm, the microcomputer software market in this country is expected to grow from \$1.85 billion in 1983 to \$12 billion in 1990. The study shows IBM Corporation at the forefront of the personal computer hardware shakeout, with about 50 percent of the market share. IBM compatible machines are expected to capture 25 percent of the market by 1990, with Commodore International Ltd., Tandy Corporation, Apple Computers, Incorporated, and other popular computer companies competing for the remaining 25 percent.

Because software developers respond to the demands generated by the hardware market, knowing which companies produce the best selling machines is a good predictor of the quantity—and often, the quality—of available applications software. Being informed about hardware is also a good indicator of the availability of parts, service, and peripherals such as printers and modems. As you can see, the hardware and software industries share a symbiotic relationship—they feed off one another to the mutual benefit of both.



# HOW TO BUY A PERSONAL COMPUTER

## FINDING APPLICATIONS SOFTWARE

Broadly speaking, there are two types of applications software. The first and most popular type is applications software such as data base management, business graphics, and word processing, covering a broad range of functions used by most businesses and many individuals. Some applications software, such as Lotus' Symphony software, combine various functions on one program. The second type of applications software provides specific professional or technical applications for specific types of businesses. For example, software specifically designed for use by medical doctors, dentists, architects, and engineers perform very specialized tasks.

Several categories of broad-range applications software are widely purchased for business and personal use. These applications software include

- ☐ Accounting—general ledger, payroll, accounts payable, and invoicing
- ☐ Communications—electronic mail interaction with central office mainframes, hook-ups with commercial data banks and other services offered by information utilities, and local area networks
- ☐ Data base management—organizing data files for central access, retrieval, and update, and compiling statistics, plot trends, and market analyses
- ☐ Educational programs—learning through games, tutorials, simulations, and other computer-based learning activities

- ☐ Financial planning—performing financial tasks such as forecasting and other complicated, time-consuming predictions
- ☐ Graphics—displaying color graphs and charts and, combined with the proper output devices, producing color slides and other visual aids
- ☐ Programming—BASIC is built into most computers

The types of performance needed from various applications software packages vary with each kind of software. For example, the high color resolution and easy-to-read chart models you need in a good graphics software package are different from the fast data handling and ease in combining files required of good data base management software. Take a realistic look at your business or personal needs when deciding upon applications software, and unless you have an unlimited income, buy only the software you need.

For example, even though the hobbyist in you may be attracted to graphics packages that can produce color slides when used with particular computers and peripheral equipment, the cost may be prohibitive. If accounting software makes your heart beat with excitement, but your accounting needs can easily be handled with a simple, old-fashioned ledger book, then accounting software is not necessary. A little forethought will save you a lot of money.

Once you've determined your needs, become informed about the capabilities and ease of use of various applications packages.

# HOW TO BUY A PERSONAL COMPUTER

- ☐ **Read reviews in computer publications.** *Personal Computing, Creative Computing, Byte, Computerworld*, and dozens of other computer publications provide up-to-date information on new software and hardware.
- ☐ **Ask friends and colleagues for their recommendations.** If possible, arrange to drop into their homes or offices to try out the application packages that might meet your needs.
- ☐ **Check your public library.** Because of copyright infringement laws, few libraries will let you take software home. However, many libraries have one or more computers and a number of software packages that you can use in the library.
- ☐ **Arm yourself with specific questions and visit your local computer store.** It's best to call ahead to make an appointment with a sales representative. Explain that you are gathering information. Find out the store's least busy time—usually early mornings—and visit when a sales representative will have time to answer your questions and demonstrate software and compatible hardware.
- ☐ **At a computer store, do a trial run on software and compatible hardware that meet your specific needs.** For example, if you need a computer for financial analysis, bring your own figures to use. If it's word processing you're after, bring a report that needs to be typed and formatted. Most stores will let you sit for a couple of hours to try out products.

## HOW TO SELECT HARDWARE

Computer hardware is the physical equipment that makes up the computer system. It includes the computer itself and all peripherals—the devices such as keyboard, monitor, disk drive, and printer that send information to the computer and receive information from it.

### RAM and Disk Drives

The biggest question most people have about selecting a computer is determining how much memory, or storage capacity, they need. If they've done the necessary groundwork of selecting which tasks they want the computer to perform and determining which software is necessary to make this happen, the memory dilemma will have solved itself. Software packages specify the amount of RAM (random access; or read/write memory) required to run the program. If you will use your computer primarily for business purposes, experts advise a minimum of 64K RAM.

Disk drives write and read information to and from disks. Most personal computers use 5¼-inch floppy mylar disks that are permanently sealed inside square plastic jackets. A cut-out slot of the disk provides access to a moving head that reads from and writes on the disk. If possible, the computer you select should be equipped with two disk drives, so that disks may be copied. Each disk should store at least 200K. Many newer machines have built-in disk drives, while other machines feature them as separate components. If speed is important, you may want to consider equip-



# HOW TO BUY A PERSONAL COMPUTER

ping your machine with a hard disk drive, which is about ten times faster and can store about ten times more information than floppy disk drives. Hard disk drives start at about \$2000.

## Disk Operating Systems

The computer's disk operating system (DOS) makes sure the computer follows all the procedures necessary to carry out the instructions you give the machine. Most computers have their own operating systems, and applications programs are compatible only with particular operating systems. The most widely used operating system is MS-DOS.

MS-DOS is the operating system for IBM Personal Computers, so a lot of MS-DOS software is being written for IBM and compatible machines. UNIX, an operating system developed by Bell Labs for engineers, is now available for 16-bit machines. Presently, little software is available, and UNIX operating systems are most attractive to people who need a system that can perform complicated scientific analyses.

## Monitors and Keyboards

The quality of what you see on the screen and touch with your fingers plays a large role in the satisfaction you will experience with your computer. The resolution, or clarity, of the image you see on the monitor is determined by the number of tiny picture elements, called pixels, it contains. The higher the density of pixels, the sharper the image displayed on the screen.

Not surprisingly, monitors with sharp images are more expensive than cheaper models with fewer pixels. Some people try to save money by hooking up their computers to their televisions and using their television screens as monitors. However, the lower number of pixels in a television monitor means the resolution will not be nearly as clear as that on a computer monitor containing densely-packed pixels.

Unless you plan to buy graphics software or high resolution color games packages, a color monitor is not necessary. Older machines featured black and white monitors, while most newer models use green or amber on a black background. The latter are easier on the eyes and give better resolution than the old white on black screens. A nonglare screen also helps make the text easier to read. A tiltable screen is another nice, but not necessary, feature.

Screen size is also important. The length of an average, good quality screen is 24 lines—the size of about one-half a typed page. Some machines, usually word processors with vertically mounted screens, can display a full page at once. Unless word processing is the only purpose for your machine, this type of screen is not necessary.

As for keyboard selection, don't even look at the cheaper machines with the small keyboards. These flat surface, membrane-covered boards make pressing keys difficult and do not have the feel of real keyboards. In addition to moveable keys, a detachable keyboard, though not essential, is certainly worth the money in terms of comfort and convenience. A detachable keyboard allows you more mobility and

# HOW TO BUY A PERSONAL COMPUTER

less rigidity in keying in information; you can even put it on your lap. Another plus to detachable keyboards quickly becomes apparent when two people use the machine to play a game. Instead of changing seats or sharing a chair, they can hand or slide the keyboard back and forth.

If you plan to use financial applications software, a separate numeric keypad on the right side of the keyboard will make entering numbers much easier than making the stretch to the top row of the regular keyboard.

Finally, how does the keyboard feel when you type? If the keys are hard to depress or the key surface is so flat that finger contact is poor, don't buy the machine. Good keyboards are designed for the comfort of touch typists. Here is a computer hardware checklist:

- 1 Is the machine equipped with enough memory to handle the software you need?
- 2 Is the disk operating system compatible with the software you've selected?
- 3 Does the monitor display a clear, crisp image?
- 4 Is the monitor large enough, and is the displayed text easy on the eyes?
- 5 Does the keyboard have good height, texture, and touch control?

## SELECTING PRINTERS AND OTHER PERIPHERALS

The word *peripheral* literally means "lying away from or outside the central part." That definition perfectly describes the relationship of

this type of equipment to computers. Peripherals are not necessary to the actual computing process, but they are important to extending the usefulness of your machine. For example, writing the great American novel on disk won't do you much good if you can't provide a paper copy for the rest of the world to read. In addition, the multitude of services such as shopping, banking, and data banks offered on-line by information utilities are unavailable to you unless you buy a modem that will connect your computer via telephone lines to that company's central mainframe.

## Printers

Criteria for selecting printers include speed and print quality. Since the printer will probably be your most expensive peripheral, take great care in making your selection. Two types of printers for personal computer owners are dot matrix printers and letter quality printers. If speed is important and appearance is secondary, an inexpensive dot matrix printer that forms each character out of grids of dots produced by a series of tiny print hammers may be your best bet. Dot matrix printers are generally very fast, but the appearance of the finished product is not typewritten, letter quality. Dot matrix printers are good for fast processing of lists of numbers and other computer data. Many people also use them for printing labels and other lists.

If it's a clean looking, quality appearance you're after, then you need the letter quality printer. Letter quality printers are slower; they produce between 12 to 60 characters per sec-



# HOW TO BUY A PERSONAL COMPUTER

ond, while dot matrix machines produce more than 250. Like dot matrix printers, most letter quality printers are impact machines. The image they produce is caused by keys striking paper. Most letter quality printers use a device called a daisy wheel that contains a letter or number at the end of each spoke. Like typewriter fonts, daisy wheels come in a variety of print styles that can be easily changed. Most can also produce underlining, boldface, italics, and other special effects.

## Modems

If you are interested in electronic mail capabilities, on-line conferencing, accessing commercial data bases, or just chatting on-line with other personal computer owners, you will need a modem, communications program, and telephone to make the connection. Communications software is every bit as important as the modem hardware you purchase. In fact, the "software first" rule applies to modem selection. As with computers, the software must be compatible with the hardware in order for the modem to work. This is particularly important when you use the modem for special purposes, such as using your home computer to access the hard disk at your office.

The speed at which modems exchange information is called the baud rate. Most newer modems are 1200 bauds. Less expensive and much slower modems with baud rates of 300 are also available. If you plan to capture or send great chunks of text or access commercial data bases—all services which are charged

according to the amount of time on the system—the faster baud rate is more practical.

## SERVICE CONTRACTS

The best assortment of software won't do you any good if your computer fails to function. That's why a good service contract is essential to protect your investment. It entitles you to ask questions and demand follow-up to possible problems—even if they are your fault.

Read your warranty carefully. Make sure the service contract does not go into effect until the warranty has expired. There's no point paying for a free service. Your friends and colleagues can also advise you about various stores' reputations.

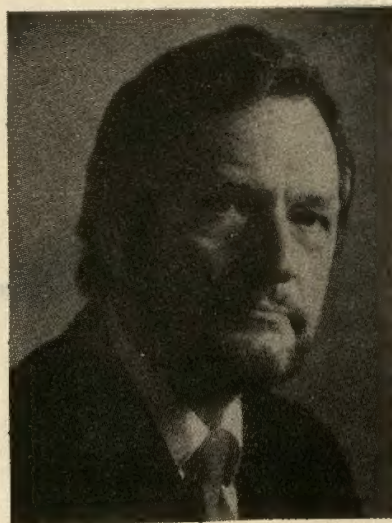
Other questions you need to investigate include:

- ☐ Does the dealer do on-site repairs, or is work on equipment done only at the shop?
- ☐ Will the dealer pick up and deliver equipment to be serviced, or is that your responsibility?
- ☐ If the dealer does pick up and deliver, is there a charge?
- ☐ Will the dealer supply "loaner" equipment while yours is being repaired?
- ☐ If you decide to "trade up" later to a more expensive machine, will the dealer give you a trade-in allowance?
- ☐ Does the contract include regular check-ups and cleaning, or is there a charge for this?

## THE AUTHOR

Donald D. Spencer is an internationally known computer science consultant, educator, and writer. He received his Ph. D. degree in computer science and has worked in the computer field for over 25 years. Dr. Spencer is the author of over 100 computer science books, including *Computers and Information Processing*, *An Introduction to Computers: Developing Computer Literacy*, *Principles of Information Processing*, *Computer Science Mathematics*, *The Illustrated Computer Dictionary*, *Introduction to Information Processing* (third edition), *Learning Turbo Pascal: A Worktext*, and *Learning BASIC for Microcomputers: A Worktext*, published by Merrill Publishing Company.

Dr. Spencer has taught computer science in college and industry and has held computer-related positions in several industrial organizations. He currently lectures to international audiences and makes presentations to teachers and students in schools and colleges on computer topics of current interest and importance. Dr. Spencer is a member of several professional and educational societies including the Association for Computing Machinery (ACM), the National Council of Teachers of Mathematics (NCTM),



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